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STAFF APPRAISAL REPORT

KOREA

NAMGANG AND TAEGU WATER SUPPLY PROJECT

July 22, 1985

Urban and Water Supply Division
East Asia and Pacific Projects Department

CURRENCY EQUIVALENTS
(As of May 1, 1985)

Currency unit	=	Won (W)
Won	=	0.00118
$1.00	=	W 850 /1

FISCAL YEAR

January 1 to December 31

WEIGHTS AND MEASURES

meter (m)	=	3.28 feet
kilometer (km)	=	0.62 miles
square kilometer (sq km)	=	0.39 square miles
hectare (ha)	=	10,000 square meters
cubic meter (cu m)	=	264 US gallons
cubic meters per second (cu m/s)	=	22.82 million US gallons per day
Gigawatt hour (GWh)	=	1 million kilowatt hours (kWh)
liter (l)	=	0.26 US gallons
liters per capita per day (lpcd)	=	0.26 US gallons per capita per day
milligrams per liter (mg/l)	=	parts per million (ppm)
metric ton (mt)	=	2,205 lb or 1 cubic meter of water
metric tons per day (mtpd)	=	2,205 lbs per day or 264 US gallons per day
pyong (py)	=	3.307 sq. m. or 35.586 sq.ft.

ABBREVIATIONS AND ACRONYMS

ADB	=	Asian Development Bank
EPB	=	Economic Planning Board
ERR	=	Economic Rate of Return
ICB	=	International Competitive Bidding
IMC	=	Inter-Ministerial Committee
IFRR	=	Incremental Financial Rate of Return
ISWACO	=	Industrial Sites and Water Resources Development Corporation
KDB	=	Korea Development Bank
KECC	=	Korea Engineering Consultants Corporation
KEPCO	=	Korea Electric Power Company
KLDC	=	Korea Land Development Corporation
MOC	=	Ministry of Construction
MOF	=	Ministry of Finance
MOHA	=	Ministry of Home Affairs
MOHSA	=	Ministry of Health and Social Affairs
NRS	=	Namgang Regional Water System
OECF	=	Overseas Economic Cooperation Fund of Japan
OOE	=	Office of the Environment
RCMA	=	MOC's Regional Construction and Management Agency
TWB	=	Taegu City Water Bureau
TWS	=	Taegu Water System
UNDP	=	United Nations Development Programme
WB	=	Water Bureau

/1 In this report "$" refers to US dollars.

KOREA

NAMGANG AND TAEGU WATER SUPPLY PROJECT

Loan and Project Summary

Borrower: Republic of Korea

Beneficiaries: Industrial Sites and Water Resources Development Corporation (ISWACO) and Taegu City.

Amount: $38 million equivalent.

Terms: Repayable in 15 years including 3 years of grace, at the standard variable rate.

Relending Terms: Government would relend $23 million of the proceeds of the loan to Taegu City for the Taegu Water System (TWS) on the same terms and conditions as for the Bank loan plus a 0.05% p.a. handling charge. After completion of the Namgang Regional System (NRS), its assets and the corresponding portion of the Bank loan amounting to $15 million, would be transferred to ISWACO on the same terms and conditions as the Bank loan plus a 0.05% p.a. handling charge. ISWACO and Taegu City would bear the foreign exchange risk.

Project Description: The proposed project consists of two water supply components: the NRS, for 13 municipalities in the Kyeongnam Province and the TWS for the city of Taegu. The project would improve water services to about 2 million persons and provide water to 520,000 additional persons by 1991. The NRS includes a water intake and about 80 kms of transmission pipelines with a capacity of 115,000 metric tons per day (tpd), a treatment plant with first stage capacity of 75,000 tpd, and storage reservoirs of 12,000 tons capacity. Complementary distribution networks in the two main project cities are being cofinanced by the Asian Development Bank (ADB).

The TWS includes water intake and transmission facilities from the Nakdong river, a 400,000 tpd water treatment plant, about 80,000 ton capacity reservoirs, the expansion of distribution networks, the rehabilitation of existing networks and a study for improving the organization of water and sewerage services.

Risks: There are no special risks in the project. The implementation schedule is feasible based on previous project experience. To avoid a possible delay in constructing complementary distribution works Government provided assurances that complementary works for the NRS would be completed by December 31, 1988.

Project Cost:	Local	Foreign	Total
	($ Million)		
Namgang Regional Water System	18.6	13.6	32.2
Taegu Water System	31.2	20.9	52.1
Base Cost	49.8	34.5	84.3
Physical Contingencies	5.0	3.4	8.4
Price Contingencies	6.5	4.5	11.0
Project Cost a]	61.3	42.4	103.7
Other Complementary Water Works	5.6	4.7	10.3
Total Water Works	66.9	47.1	114.0
Interest During Construction	2.7	5.6	8.3
Total Financing Requirements	69.6	52.7	122.3
FINANCING PLAN:			
IBRD	0.0	38.0	38.0
Government Contributions for NRS	22.9	3.3	26.2
ADB (NRS's Distribution Works)	0.0	4.0	4.0
Internal Cash Generation and Bonds from cities in NRS	5.9	1.2	7.1
Taegu's Bonds	19.0	0.0	19.0
Taegu's Internal Cash Generation	13.6	6.2	19.8
Government Loans for Taegu	8.2	0.0	8.2
Total Financing	69.6	52.7	122.3

	Bank Fiscal Years				
Estimated Disbursements:	1986	1987	1988	1989	1990
Annual	3.0	8.8	14.8	9.8	1.6
Cumulative	3.0	11.8	26.6	36.4	38.0

Economic Rate of Return: 16%

a] Including Duties and Taxes estimated at $ 8 million equivalent

KOREA

STAFF APPRAISAL REPORT

NAMGANG AND TAEGU WATER SUPPLY PROJECT

Table of Contents

This report is based on the findings of an appraisal mission consisting of Messrs. C. Fernandez (Financial Analyst) and E. Fernando (Engineer), who visited Korea in April 1985. Ms. Elisabeth Hellman assisted in preparing the report.

I. THE WATER SUPPLY AND SANITATION SECTOR

Country Background

1.01 Korea's population in 1984 was 40.6 million. Its population density of 410 persons/sq km is one of the highest in the world; it is also one of the most urbanized of the developing countries. The overall population growth rate has decreased from 3% in 1960 to about 1.5% at present. The urban population in the 187 largest municipalities, which represents 60% of the total, has been increasing by 5% p.a. or about three times the estimated growth rate of the total population. By the end of the century, the population living in municipalities of more than 50,000 inhabitants is expected to include about 80% of the total population. This rapid urbanization has overextended all urban services, especially water supply. Coupled with accelerated industrial growth and the relatively low priority given to the sector earlier, this has led to a decline in the quality of the environment and in water shortages with rationing in many cities. Since the 1970s, the Government has given increased priority to social infrastructure which has resulted in significant improvements in the water supply and sanitation sectors and contributed to improvements in public health. Waterborne diseases have declined steadily since 1971. The crude death rate also declined from 13 to 7 per thousand persons between 1960-81, while life expectancy increased from 53 to 66 years in this period.

Sector Organization

1.02 There is no single agency with overall responsibility for the sector. At the Central Government level, four Ministries are directly involved in the sector. The Ministry of Construction (MOC), through its Water and Sewerage Bureau, is responsible for the planning, design and construction of major water and sewerage works. The Industrial Sites and Water Resources Development Corporation (ISWACO), a semi-autonomous public corporation under MOC, operates regional systems providing water in bulk to groups of municipalities and industrial zones and builds and operates multipurpose dams. The Ministry of Home Affairs (MOHA), through its Local Finance Bureau, oversees the operation of municipal Water Bureaus (WBs), including the approval of bonds, loans and tariffs and the expansion of distribution and storage facilities. The WBs are semi-autonomous organizations, responsible for the design, construction, operation and financial management of water works under the municipal governments. They have separate budgets, revenues and expenditures. The Ministry of Health and Social Affairs (MOHSA) is responsible for setting standards, controlling the quality of drinking water and implementing rural water supply programs. The Office of the Environment (OOE), under MOHSA, sets, regulates and coordinates pollution control. The OOE also has to approve, under the Environmental Preservation Law, projects which have a substantial impact on the environment. Finally, the Economic Planning Board (EPB) sets guidelines for tariff increases, approves investment plans and allocates counterpart funds for the sector.

Sector Financing and Tariffs

1.03 Regional bulk water supplies to municipalities are financed by MOC budgets and foreign loans. After completion, such projects and their corresponding debt service liabilities are handed over to ISWACO for operation and maintenance. ISWACO's national bulk water tariffs are approved by MOC and EPB. Some 25-40% of the investments by municipal WBs are financed by MOC and provided to the WBs as loans, at commercial rates, through the Korea Development Bank (KDB). The balance of investment funds required are provided by the WBs' internal generation (15-35%), sales of municipal bonds (20-40%), and foreign loans. The EPB provides guidelines for the WB's maximum annual retail tariff increases which reflect macroeconomic policies, and MOHA approves water tariffs for WBs within these guidelines. Water tariffs have generally been sufficient to cover operation, maintenance, debt service and some contribution to capital investments. In the rural sector, a successful rural water supply program, scheduled for completion in 1986, is being implemented, with the provincial governments, the villages and MOHSA each financing one third of the costs. Sewerage is financed from municipal revenues, government and foreign loans, and, starting in 1985, from sewerage tariffs. Despite these measures financial problems still remain as described in para. 1.08.

Service Levels

1.04 About 55% of the population was served by piped water in 1980, compared with 17% in 1960 and 33% in 1970. Service levels are better (83%) in the large cities. However, many municipalities suffer from restricted supply and water rationing. The quality of treated water is uneven. Municipal water systems produce about 260 liters per capita per day (lpcd), of which about half is for non-residential use. To assist the Government resolve the problem of unaccounted-for water, the Bank is providing support to leak detection programs in some 20 cities.

1.05 Only 8% of dwellings use sewerage systems; the rest use septic tanks, cesspits, and night soil collection systems. Most of the waste water from residential and industrial premises is discharged untreated or partially treated into street drains. This, combined with high leakage and the possibility of infiltration, exposes distribution systems to the risk of contamination. Increased emphasis is now being given to sewerage and waste disposal (para. 1.06). Seoul and Pusan, the two largest cities, and several other municipalities have established combined waste and storm water collection systems and sewage and night soil treatment plants, serving about one third of their populations. The OOE and the municipalities are also enforcing pollution control measures on industry and commerce in an effort to improve the quality of rivers and the environment.

Sector Development

1.06 Sector investments in 1983 prices increased from $218 million in the Third Plan (1972-76), to $530 million in the Fourth Plan (1977-81) and are forecast to reach $1,860 million during the Fifth Plan (1982-86), with about half being financed from the Government budget. Government objectives during the Fifth Plan include preservation of water quality, replacement of obsolete equipment, and expansion and construction of new sewerage and water supply systems and treatment plants. The target for the Fifth Plan is to increase the population served by piped water from 55% to 70% by 1986. Given the high rate of urban population growth, maintaining even the present coverage requires substantial investments. The Fifth Plan provides for a number of environmental pollution abatement measures, including the improvement of the Han River Basin (based on a Master Plan completed in 1984), the expansion of combined sewerage systems, and the building of night soil and sewage treatment plants in some 100 cities and towns. Government plans to increase the percentage of population served by sewage treatment plants from 6% to 35% and sewage treatment capacity from 0.5 million tpd to 8 million tpd between 1980 and 1991. Sanitation investments in the Fifth Plan are estimated at $800 million in 1982 prices.

Sectoral Issues and Constraints

1.07 Although Korea has achieved impressive progress in the provision of water services, many problems still remain. At the present growth rate of 5% p.a., the urban population doubles every 14 years which, combined with rapid industrialization, dramatically increases water requirements. Consequently, in spite of a per capita production of about 300 lpcd in several major cities, significant water shortages continue requiring continuous investments in the sector.

1.08 The main outstanding sectoral issues, which are being discussed with the Government, are summarized below:

(a) Financial. Although water supply projects require lengthy construction periods and reach full capacity only several years after commissioning, the investment funds available to most municipalities are short-term bonds, internal cash generation and annually approved government contributions. This results in project investments with relatively short design horizons being favored. This problem could be alleviated with the establishment of financial mechanisms, presently being discussed, for long-term financing of urban and water investments. The lack of nation-wide financial criteria for setting WBs' retail tariffs and ISWACO's bulk water tariffs also creates uncertainty about their capacity to assume debt service liabilities and finance long-term project investments. Some projects are financed by grants from Government even when debt financing would be preferable and affordable. ISWACO's bulk water tariffs for treated and raw water have a national impact and affect many municipalities. A country-wide study of the bulk water tariff policy would be undertaken by ISWACO under Loan 2491-KO and presented to the Bank for comments by June 30, 1986. This study would be financed and implemented by ISWACO in

coordination with EPB and MOC. Assurances were obtained during negotiations that the bulk tariff study including recommendations for the NRS would be completed not later than June 30, 1986. Confirmation was also obtained during negotiations that the consultants for this study would be appointed not later than August 31, 1985.

(b) Organization in Interurban Areas. The WBs are generally well operated and maintained. However, municipal water systems are independently planned and operated even where contiguous municipalities constitute a single integrated urban area. Coordinated services would increase efficiency, remove unfairness in the access to water or sewerage services, eliminate duplication of investments and reduce dependence on government grants. To address this problem MOHA engaged the Korea Public Administration Research Institute to prepare a country-wide feasibility study of the organization of urban water supply services. The study, completed in 1984, is now being reviewed by the Ministries concerned and the Bank. MOHA also intends to undertake a detailed study of the organization of water services in the Metropolitan Region (comprising some 40 municipalities around Seoul City). This study would be completed and made available to the Bank for comments.

(c) Division of Responsibilities. Government has hitherto successfully implemented a large program of sector investments. However, there is some lack of coordination between the Ministries involved in the sector, in particular between MOC and MOHA. This is partially due to the division of responsibilities and is a problem common to other sectors as well because of the Government's vertical organization. A clearer division of responsibilities and closer coordination is desirable. An Inter-Ministerial Committee (IMC) established under Loan 2072-KO meets on an ad-hoc basis to discuss particular sector coordination issues. Inter-Ministerial meetings are presently discussing the setting up of mechanisms for sector financing.

(d) Independent Water and Sewerage Organizations. MOC's Water and Sewerage Divisions were reorganized under a new Bureau in 1984. However, at the municipal level, with the exception of Seoul City, the responsibility for water and sewerage rests with two separate Bureaus. Increasing urban population and density, higher water consumption and industrialization requires a large effort to improve sewerage services and reduce pollution. In most countries, the integration of water and sewerage services under the same management has proven efficient in terms of staffing, finances, accounting, planning and coordination. It is important to study the feasibility of this integration for the particular conditions of Korea. Assurances were obtained during negotiations that MOHA would carry out the review of the organization of water and sewerage services in Taegu City and that the conclusions of this review would be made available to the Bank for comments not later than December 31, 1986.

(e) Scarce Water Resources. Korea has limited water resources. Per capita surface water runoff is only about 1,700 cu m or about 40% and 12% respectively of the water runoff of Japan and the United States. Since two thirds of the annual precipitation of 1,160 mm occurs during

the rainy season (July to September), increased water demand requires the construction of multipurpose reservoirs and regional water transmission systems with long transmissior pipelines and expensive pumping. The cost of such facilities is increasing rapidly due to the shortage of suitable dam sites and increasing land costs. It is important, therefore, to improve water resources management, especially for the four largest rivers - Han, Nakdong, Geum and Yongsan - the basins of which contain 70% of the industry and urban population. Government's plans for these river basins include the implementation of water conservation programs in the municipalities, master plans for the use of water, and rational pricing policies to help curtail water demand.

(f) Air and Water Pollution. High population density, increased ownership of vehicles, the use of coal for heating, and especially the wastes generated by rapid industrialization have resulted in a deterioration of air and water quality. The Government enacted the Environmental Preservation Law in 1981, and the OOE and the municipalities are starting country-wide programs for sewerage and sewage treatment and control of industrial air and water pollution.

Bank Objectives and Lending in the Sector

1.09 The Bank's lending strategy is to finance high priority investments included in government programs and through these operations maintain a dialogue on important sector issues. Through its support of Government's programs for water supply and sanitation, the Bank has the following key objectives:

(a) to promote sound investment planning with emphasis on least-cost alternatives, improve the efficiency of the use of water resources, safeguard the environment and ensure that the benefits of water and sanitation reach the poor;

(b) to strengthen sector institutions and improve coordination; and

(c) to develop a solid financial basis for the sector, through improvements in accounting, financial and management information services, and the adoption of appropriate policies for financing and cost recovery.

Experience with Past Lending

1.10 The Bank has financed three projects in the water supply sector since 1982: the First Water Supply Project (Loan 2072-KO) for expansion of water services in five cities; the Second Water Supply Project (Loan 2350-KO) for the Nakdong Barrage to increase water availability for municipalities in the Nakdong basin, initiate leak detection programs and improve the financial management of WBs; and the Metropolitan Region Water Supply Project (Loan 2491-KO), approved in February 1985, to provide bulk treated water to 25 municipalities, and to study bulk water tariff policies, analyze the organization of water services in the Metropolitan Region, and improve ISWACO's financial management. All these projects are being implemented on schedule and compliance with loan covenants is satisfactory. Bank

projects have also resulted in significant cost savings through selection of least cost investments. Important sector improvement measures are being undertaken by Government. These include: (a) the establishment of sewerage tariffs for the main cities; (b) introduction of improved accounting regulations and procedures for all WBs; (c) agreement to introduce marginal cost pricing for the water available from the Nakdong Barrage; (d) the establishment of financial performance targets for ISWACO and several WBs; (e) the transfer of appropriate leak detection technology; (f) the introduction of microcomputers for accounting and financial management to WBs; and (g) the introduction of environmental management programs. The Bank liaises closely with other international agencies supporting the sector.

Rationale for Bank Involvement

1.11 Bank support for this project would continue, expand and sustain the above mentioned sector improvements. Bank's involvement in project preparation has already resulted in the adoption of a less expensive and more efficient treated water system (para. 6.04). The project assist in applying sound pricing policies and tariffs, improve the organization of water and sewerage services in Taegu and achieve the objectives described in para. 3.02. Institutional changes, particularly those affecting several Ministries, are politically sensitive and would require time to be addressed.

II. WATER DEMAND

Introduction

2.01 Water consumption has been rising rapidly in Korea. The percentage of population with house connections increased from 33% in 1970 to 61% in 1984. Although the additional population served belongs to the lower income brackets, which would normally reduce the per capita consumption, the water production per person for the whole country increased from 117 lpcd in 1970, to 240 lpcd in 1980 and 273 lpcd in 1983. This rapid increase in per capita demand, 6.7% p.a. during the last 13 years, is explained by the progressive alleviation of water supply shortages, rapid industrialization and urbanization, and higher living standards. The same factors would continue to increase water consumption in the future, but at a slower rate.

Namgang Regional System (NRS)

2.02 The proposed NRS subproject would provide treated water to 13 municipalities including the cities of Samcheonpo and Chungmu in south-eastern Korea, (Map IBRD 18965R). In 1983, the population of these municipalities was 251,000 persons. Water shortages have been a major hindrance to development of the area, which lags considerably behind other areas. In 1983, the population served by house connections in these 13 municipalities was 138,000 persons (55% of the population). Water production was 17,850 metric tons or 130 lpcd. Unaccounted-for water (37%) reduced the water consumption to only 82 lpcd. Access to water services is uneven, and no public water supply is available in nine of the thirteen municipalities. In the other four, water is rationed and dry season consumption can be limited to less than 40 lpcd. These water shortages have resulted in serious conflicts between municipalities for the use of limited water from ground water sources. The region does, however, have good development potential for tourism, fishery and export-related industrial development. Infrastructure for these purposes is presently being constructed. Ongoing works include three industrial estates and a new harbor in Samcheonpo, and a large tourist development in Chungmu. These two cities are expected to require about 80% of the NRS's capacity. The NRS has priority in government plans for the sector because of the water shortages and rationing, and the development potential of the region. A description of the existing water supply facilities for the 13 municipalities is presented in Annex 1.

2.03 Population projections for the NRS, based on MOC's "Second Comprehensive National Physical Development Plan 1982-91", the feasibility study (para. 3.01) and appraisal projections indicate that the population in the project municipalities would increase from 251,000 persons in 1983 to 316,000 in 1991 (2.9% p.a.) and 415,000 in 2001 (2.7% p.a). However, the smaller municipalities generally have small or negative rates of population growth (Annex 3 A). Demand projections for the two cities assume that over 90% of the population would be connected within the next ten years. However, some of the project municipalities include many small villages surrounding the main town, some of which are distant or separated from the pipeline

route by physical obstacles. In such cases it is estimated that only 70% of the population would be served by 1991. The percentage of population with house connections is expected to increase from 55% in 1983 to 75% in 1988 and 82% in 1991. Detailed population and demand projections are presented in Annex 3 and summarized in Graph 2.1.

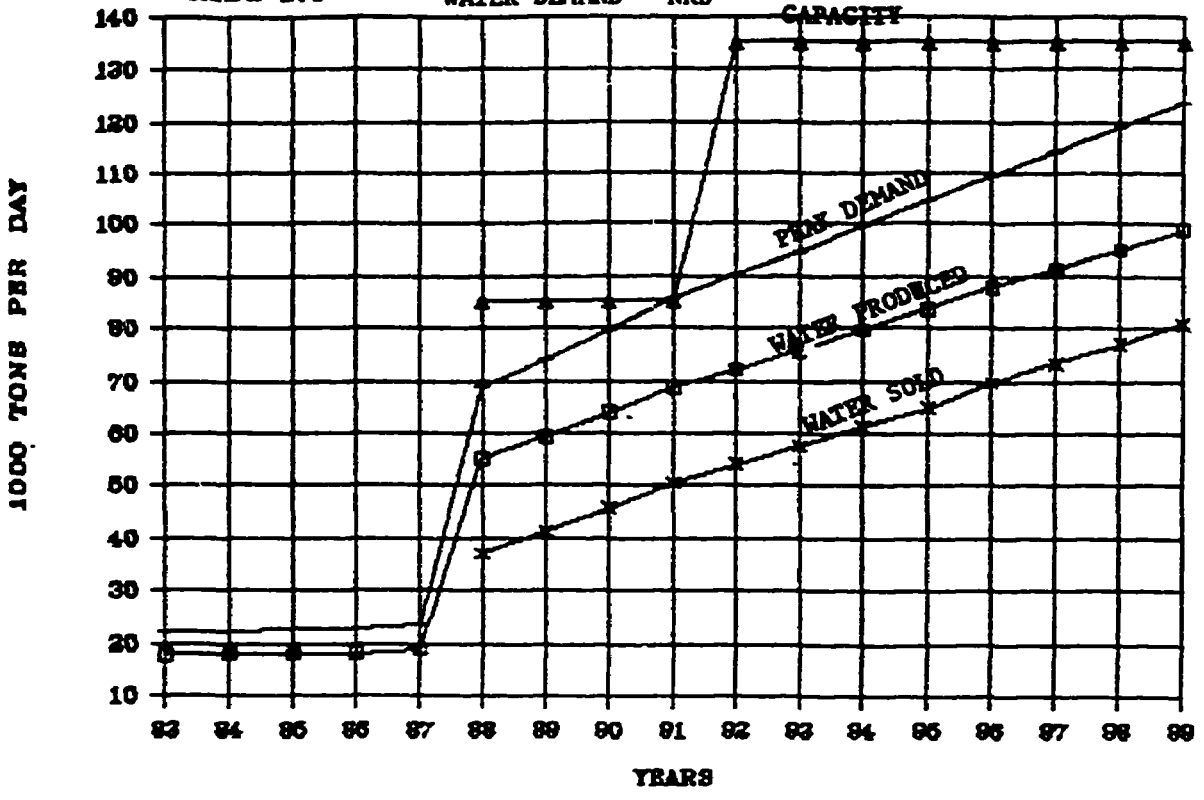
2.04 The feasibility study for the NRS estimated the water consumption using statistics from other Korean cities which have no serious water rationing. These projections are reasonable. Water consumption is estimated to increase from 11,230 tpd (averaging 82 lpcd in the four municipalities served) in 1983, to 48,000 tpd (172 lpcd) in 1991, and 77,000 tpd (188 lpcd) in 2001. The water supplied by the proposed project would increase even faster. This is because Chungmu City would have to abandon most of its present water sources, which belong to other towns (not included in the project), and because the increase in water demand by Samcheonpo's industrial estate would gradually reduce the water available from the industrial pipeline. The capacity of the first stage treatment plant and pumping stations is 75,000 tpd, to be expanded to 115,000 tpd by 1992. A second stage treatment plant would be built at this time, providing a total capacity of 42,300 tpd to the Samcheonpo branch and 72,700 tpd to the Chungmu branch. The pipelines are dimensioned for the capacity requirements up to the year 2001.

2.05 Leak detection programs and network rehabilitation works being constructed under an ADB-financed project are expected to reduce unaccounted-for water in Chungmu and Samcheonpo from 37% to 30% by 1991. The total unaccounted-for water, including the new systems, is expected to be 28% after 1991.

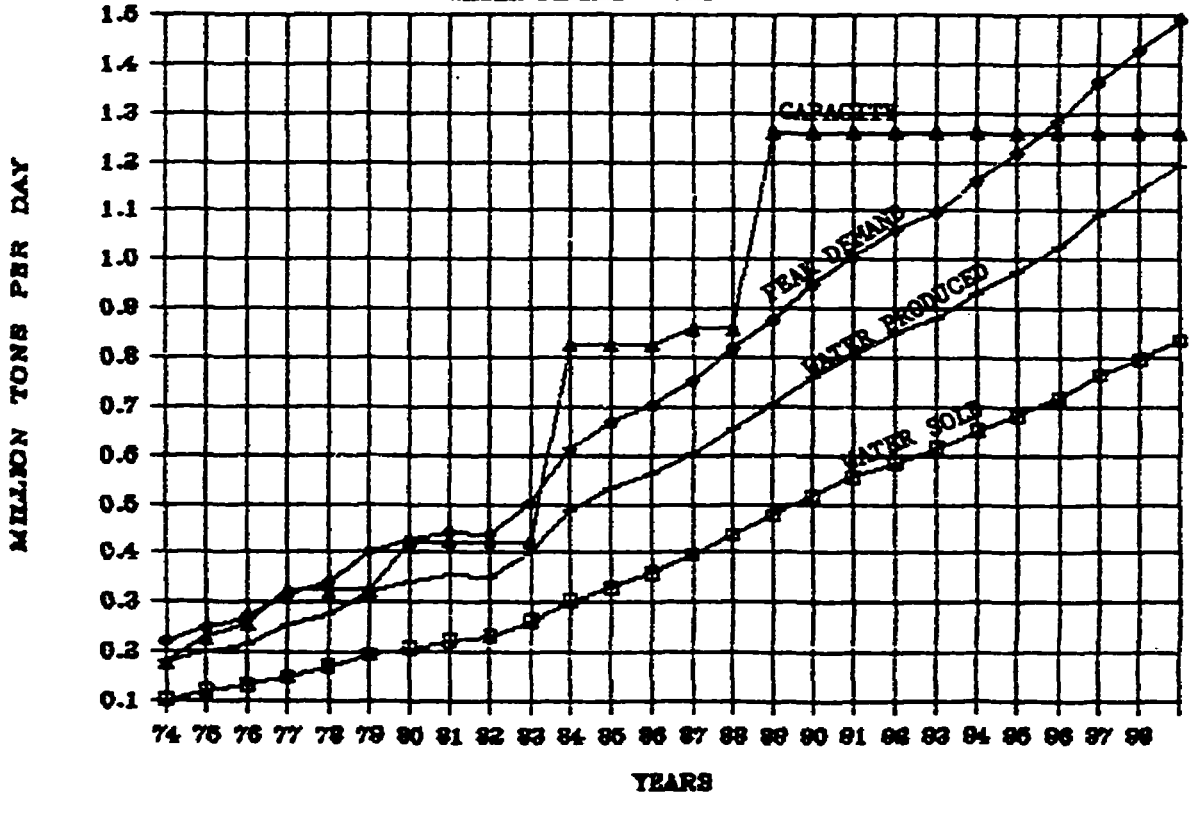
Availability of Water for the NRS

2.06 Studies made of water resources available in the Namgang Reservoir indicate that if the reservoir is operated as originally designed, there would be sufficient water available to meet all projected demands including the additional demand of this project. This would require completion of land acquisition and compensation for some 340 ha, which would allow the reservoir to operate, as originally designed, at a high flood level of 39.5 m. ISWACO operates the reservoir and is undertaking a satisfactory program for land acquisition. Assurances were obtained during negotiations that to provide adequate water supply to the NRS municipalities MOC would complete a program of land acquisition in accordance with a schedule satisfactory to the Bank. At present a considerable volume of water from the reservoir is used by the Korea Electric Power Company (KEPCO) for relatively small power generation (12,600 KW, because of the low hydraulic head). This power can easily be supplied from other power stations. The NRS would have sufficient water available for municipal demand at all times if the volume of water used by KEPCO is curtailed, and appropriate compensation is paid for the resulting reduction in powe r generation. MOC confirmed during negotiations that public water sup ply would have priority in the allocation of water resources from the Namgang Reservoir.

GRAPH 2.1 WATER DEMAND - NRS



GRAPH 2.2 WATER DEMAND - TWS



Taegu Water System (TWS)

2.07 Taegu, with a population of two million persons, is the third largest city in Korea (Map IBRD 18966R). Taegu is one of three Special Cities and reports directly to MOHA rather than to the provincial government. Water consumption in 1984 was 111 million tons (160 lpcd). The population served by house connections was 1.9 million persons, (94%), but access to water is uneven, with levels of service between 80% and 98% in different parts of the city. Under the TWS particular attention has been given to reach the poorest, unserved areas. The computer simulation of the water networks shows that after completion the project would solve present problems of water rationing, low pressures, intermittent supply and provide sufficient water to all neighborhoods.

2.08 Taegu's population growth averaged 5.1% p.a. during the last 15 years, compared to an average of 5.9% p.a. for the 52 largest cities. MOC's population projections estimate that Taegu's growth rate will slow down, with its population increasing from 2.03 million in 1984 to 2.60 million in 1991 (3.6% p.a.) and 3.15 million in 2001 (1.9% p.a). Taegu is planning to increase the percentage of the population with house connections from 94% in 1984 to 98% in 1991. The additional population served would increase by 400,000 persons by 1991 and 780,000 persons by 1995. Detailed population and demand projections for the TWS are presented in Annex 3 B and summarized in Graph 2.2.

2.09 The feasibility study for the TWS (para. 3.01) and the city's own projections forecast a large increase in water demand, due to: (a) the elimination of rationing and improved pressures upon completion of the First Water Supply Project; (b) rising standards of living e.g., more extensive use of flush toilets, private baths, and water consuming appliances like washing machines; and (c) increasing industrial and commercial development. This has been the experience in similar cities in Japan and other developed countries. These projections also assume that per capita water production would increase from 272 lpcd in 1984 to 430 lpcd in 1991 (6.8% p.a.), and to 570 lpcd in 2001 (2.9% p.a.). Under the city projections, the project capacity would be fully used by 1992, and it would thus be necessary to start the construction of an additional dam (Daecheon) by MOC, and the corresponding treatment plant (Geumho) and pipeline facilities by Taegu within the next few years.

2.10 The demand projections were revised and scaled down by the consultants (KECC) during the appraisal. The demand projections used for the appraisal assume a slower and more gradual increase in per capita water consumption and a reduction of the unaccounted-for water (Annex 12, para. 16). Under the appraisal projections water consumption is expected to increase from 263,000 tpd (146 lpcd) in 1983 to 556,000 tpd (218 lpcd) in 1991 (Annex 3B), and the project capacity of 400,000 tpd would satisfy Taegu's water demand up to 1995. If the water demand increases as projected by the city, the financial position of TWB and the economic rate of return for the TWS would be even better than the appraisal projections.

2.11 Unaccounted-for water in Taegu rose from 32% to 38% in 1984, when pressures were increased upon the expansion of water capacity and the completion of works under the First Water Supply Project. Reducing Taegu's leakage is difficult because of the large proportion of old distribution pipes in the system. In 1985, a leak detection program, with the support of foreign experts, was started, aiming to reduce unaccounted-for water to less than 30% by 1990. This program would also establish a permanent unit in TWB for leak detection and control. A considerable investment in network rehabilitation is partially financed under the proposed project, with the remainder wholly financed from internal cash generation.

III. THE PROJECT

Origin and Formulation

3.01 The proposed project is an important part of Government's plans to upgrade and expand water services in water-scarce regions and urban areas. The project was identified and feasibility studies completed under Loan 2072-KO. Detailed engineering for the NRS is being financed by MOC and prepared by Woo Bo Engineers Inc. (Korea), in association with Renardet Engineering (France). Detailed engineering for the TWS is being financed by Taegu City and prepared by Korea Engineering Consultants Corporation (KECC) with the assistance of Nihon Suido and Original Engineering (Japan).

Project Objectives

3.02 The main project objectives are to: (a) provide adequate and reliable water supply to 13 municipalities located in a water scarce and poor area of the country and promote their social and industrial development; (b) increase water supply coverage in Taegu and ensure adequate water services particularly to the low-income population; (c) review the organization of water and sewerage services in Taegu, which is expected to serve as a model for other cities; (d) extend the scope of ISWACO's national bulk water tariff policy study to include the NRS; and (e) promote sector development through a continued dialogue with the Government (paras. 1.08-1.11).

Project Description

3.03 The proposed project consists of two water supply components in the Kyeongsang Region: the Namgang Regional System (NRS) and the Taegu Water System (TWS). The subprojects have been approved by the National Assembly and would be implemented simultaneously between 1985 and 1988. Details of the subprojects are presented in Annex 2, and a summary description is presented below:

(a) Namgang Regional System. This subproject would provide treated water to 13 municipalities, including two cities (Chungmu and Samcheonpo), and eleven towns (eups) and villages (myeons). The NRS includes a water intake and raw water pumping station from

the existing Namgang Reservoir, a raw water transmission pipeline, a new water treatment plant (75,000 tpd), a high level reservoir on the Chungmu branch line and two main transmission pipelines, one serving five towns and Samcheonpo City, and the other serving six towns and Chungmu City. This subproject also includes consultant services for project supervision and for studying ISWACO's bulk water tariff policies.

(b) Taegu Water System. This subproject would eliminate water rationing in Taegu after 1988, and provide water supply to some 780,000 additional persons by 1995. It includes the expansion of the water intake and pumping station from the Nakdong River, the expansion of the Dasa treatment plant by 400,000 tpd, and additional transmission and distribution facilities to use this capacity and distribute water to all areas of the city. The TWS includes additional booster pumping stations, service reservoirs, the replacement of old and leaking distribution pipes and the improvement of instrumentation and control of the whole system. Consultant services for project supervision and the review by MOHA of the organization of water and sewerage services in Taegu City are also included in the project.

Complementary Works

3.04 Complementary distribution works necessary to utilize the water delivered by the NRS have been designed and are under construction for the two main cities of Chungmu and Samcheonpo with parallel cofinancing from ADB (Small Towns Water Supply Sector Project). The two cities would use about 80% of the project capacity. The eleven other municipalities would implement a program of distribution improvements that would be financed by MOHA's Provincial Water Fund. Assurances were obtained during negotiations that the distribution works requ for the municipalities of the NRS works would be coordinated by C and MOHA and implemented not later than December 31, 1988.

Project Cost

3.05 The estimated project cost, including physical and price contingencies, is W 84.5 billion ($103.7 million), of which W 34.6 billion ($42.5 million) is the foreign exchange component. Taxes and duties are estimated at about $8 million equivalent. The base cost is expressed in June 1985 prices. The project is in an advanced stage of preparation, and cost estimates are based on detailed designs, MOC's annually updated rates and prices and recently awarded contract prices for similar works. Physical contingencies have been estimated at 10% of total base costs. Technical assistance for construction supervision is included in the project costs and requires about 100 man-months of foreign consultants and about 340 man-months of local consultants. Estimated price increases over the project period amount to about 7% of base costs plus physical contingencies. Price increases for foreign costs are estimated at 5% for 1985, 7.5% for 1986, and 8% for 1987-1988. Price increases for local costs are estimated at 2.5% for 1985, 5% for 1986, and 5.5% for 1987-1988. It is estimated that exchange rate adjustments would, on the average, maintain "purchasing

TABLE 3.1 - PROJECT COST NAMGANG AND TAEGU WATER SUPPLY PROJECT 1]

WORKS	MILLION WON			% OF BASE COST	MILLION US$			% FOREIGN	MILLION US$			
	Local	Foreign	Total		Local	Foreign	Total		1986	1987	1988	1989
[1] NAMGANG REGIONAL WATER SYSTEM:												
INTAKE	638	377	1017	3.7%	0.8	0.4	1.2	37.1%	0.0	0.7	0.5	0.0
RAW WATER TRANSMISSION	2291	2144	4435	16.2%	2.7	2.5	5.2	48.4%	0.0	2.3	2.3	0.5
WATER TREATMENT PLANT	2393	1913	4307	15.7%	2.8	2.3	5.1	44.4%	0.0	2.0	2.2	0.8
TREATED WATER TRANSMISSION	5319	4871	10190	37.2%	6.3	5.7	12.0	47.8%	0.0	4.8	4.8	2.4
SERVICE RESERVOIRS	233	100	333	1.2%	0.3	0.1	0.4	30.0%	0.0	0.2	0.2	0.0
TUNNELS	400	215	615	2.2%	0.5	0.3	0.7	35.0%	0.0	0.4	0.4	0.0
INSTRUMENTATION & CONTROLS	300	1700	2000	7.3%	0.4	2.0	2.4	85.0%	0.0	0.7	1.2	0.5
LAND ACQUISITION	580	0	580	2.1%	0.7	0.0	0.7	0.0%	0.1	0.4	0.1	0.0
ENGINEERING & TECH. ASSIST.	800	200	1000	3.6%	0.9	0.2	1.2	20.0%	0.0	0.5	0.5	0.2
TAXES & DUTIES	2825	0	2825	10.3%	3.4	0.0	3.4	0.0%	0.0	1.4	1.5	0.5
BASIC COST, PRICES JUNE 1986	15980	11521	27401	100.0%	18.7	13.5	32.2	42.0%	0.1	13.4	13.8	5.0
PHYSICAL CONTINGENCIES	1598	1152	2740	10.0%	1.9	1.4	3.2	42.0%	.0	1.3	1.4	0.5
PRICE CONTINGENCIES	1291	870	2131	7.8%	2.4	1.7	4.1	41.5%	.0	0.8	2.1	1.2
[1] TOTAL COST NMG	18730	13543	32273	117.8%	22.9	16.6	39.5	42.0%	0.2	15.5	17.2	6.6
[2] TAEGU WATER SYSTEM:												
INTAKE	1040	960	2000	4.5%	1.2	1.1	2.4	48.0%	0.0	1.4	0.9	0.0
TREATMENT PLANT	10400	7600	18000	40.7%	12.2	8.8	21.2	42.2%	1.5	7.2	7.0	5.5
TRANSMISSION PIPELINES	1473	1627	3100	7.0%	1.7	1.9	3.6	52.5%	0.4	2.3	1.0	0.8
DISTRIBUTION NETWORKS	1968	1432	3300	7.5%	2.2	1.7	3.9	43.4%	0.0	1.0	1.6	1.3
SERVICE RESERVOIRS	3380	1440	4800	10.8%	4.0	1.7	5.6	30.0%	0.0	1.7	1.7	2.3
PUMPING STATION	386	214	600	1.4%	0.5	0.3	0.7	35.7%	0.0	0.2	0.3	0.2
NETWORK REHABILITATION	2626	2214	4840	10.8%	3.1	2.6	5.7	46.7%	0.0	1.7	2.3	1.7
OTHER WORKS	85	1915	2000	4.5%	0.1	2.3	2.4	95.8%	0.0	0.4	1.0	1.0
LAND	750	0	750	1.7%	0.9	0.0	0.9	0.0%	0.4	0.4	0.2	0.0
TAXES & DUTIES	3800	0	3800	8.5%	4.5	0.0	4.5	0.0%	0.4	1.8	1.3	0.9
ENGINEERING & TECH.ASSIST.	899	376	1075	2.4%	0.8	0.4	1.3	35.0%	0.1	0.4	0.4	0.4
BASIC COST, PRICES JUNE 1986	26457	17778	44235	100.0%	31.2	20.9	52.1	40.2%	2.8	18.4	17.8	13.3
PHYSICAL CONTINGENCIES	2648	1778	4427	10.0%	3.1	2.1	5.2	40.2%	0.3	1.8	1.8	1.3
PRICE CONTINGENCIES	2122	1451	3573	8.1%	4.1	2.9	6.9	41.3%	.0	1.1	2.6	3.3
[2] TOTAL COST TWS	31228	21007	52235	118.1%	38.3	25.9	64.2	40.3%	3.0	21.3	22.0	17.2
[A] PROJECT COST (Parts 1 and 2):												
NAMGANG REGIONAL SYSTEM	15980	11521	27401	38.2%	18.7	13.8	32.2	42.0%	0.1	13.4	13.8	5.0
TAEGU WATER SUPPLY SYSTEM	26457	17778	44235	61.8%	31.2	20.9	52.1	40.2%	2.8	18.4	17.8	13.3
BASIC COST, PRICES JUNE 1986	42387	29298	71685	100.0%	49.8	34.5	84.3	40.9%	2.8	31.8	31.4	18.3
PHYSICAL CONTINGENCIES	4237	2930	7167	10.0%	5.0	3.4	8.4	40.9%	0.3	3.2	3.1	1.8
PRICE CONTINGENCIES	3384	2321	5705	8.0%	8.4	4.5	11.0	40.7%	.0	1.8	4.8	4.5
[A] PROJECT COST	49998	34550	84538	118.0%	61.3	42.5	103.7	40.9%	3.2	36.8	39.2	24.6
[B] COMPLEMENTARY WATER WORKS:												
SANCHEONPO & CHUNGMU	3910	3400	7310		4.8	4.0	8.8	46.5%	2.8	3.4	2.8	
OTHER TOWNS IN NMG	875	584	1459		1.0	0.7	1.7	40.0%	0.5	0.7	0.5	
[B] COMPLEMENTARY WATER WORKS	4785	3984	8769		5.8	4.7	10.3	45.4%	3.1	4.1	3.1	
[C] TOTAL WATER WORKS	54773	38534	93307		68.8	47.1	114.0	41.3%	6.3	40.9	42.3	24.6
[C] INTEREST DURING CONSTRUCTION:												
NAMGANG REGIONAL SYSTEM	0	1381	1381		0	1.7	1.7		0.0	0.2	0.5	1.0
TAEGU WATER SYSTEM	2727	1944	4671		2.4	3.4	5.8		0.1	0.7	2.0	3.1
COMPLEMENTARY WATER WORKS	255	426	680		0.3	0.5	0.8		0.1	0.2	0.5	0.0
[C] INTEREST DURING CONSTRUCTION	2982	3750	6732		2.7	5.8	8.3		0.1	1.1	3.0	4.0
[D] TOTAL FINANCING REQUIREMENTS	57755	42284	100039		69.5	52.7	122.3		6.4	42.1	45.3	28.6

1] Due to rounding the last digit in totals may appears different from the sum of digits.

power parity" during the project implementation period. The project cost summary is shown in Table 3.1. Detailed project cost estimates are presented in Annex 4.

Financing Plan

3.06 The proposed Bank loan of $38 million would finance 36.6% of the project cost (39.7% excluding taxes), or about 31.1% of the total financing requirement of $122.3 million, including the complementary distribution works of the municipalities in the NRS and the interest during construction, (Table 3.2). The remaining funds would be provided by Government contributions for the NRS ($26.2 million, 21.4%), Taegu City bonds (19 million, 15.5%), Taegu Water Bureau internal cash generation ($19.8 million, 16.2%), Government loans ($8.2 million, 6.7%), ADB ($4 million, 3.3%), and internal generation and bonds by the cities in the NRS ($7.1 million, 5.8%). This financing plan was reviewed and confirmed during negotiations. After project completion, the assets and debt service liabilities of the NRS would be transferred to ISWACO. Taegu City will own and operate the TWS subproject.

TABLE 3.2 PROJECT FINANCING PLAN 1]

	MILLION US$			% OF TOTAL	TOTAL MILLION	MILLION WON				
	Local	Foreign	Total	COST	WON	1985	1986	1987	1988	1989
NAMGANG REGIONAL SYSTEM	22.9	16.6	39.5	32.3%	32273	128	12896	13939	5310	0
TAEGU WATER SYSTEM	38.3	25.9	64.2	52.5%	52265	2590	17674	17817	14184	0
PROJECT COST	61.3	42.5	103.7	84.8%	84538	2718	30570	31755	19494	0
OTHER COMPLEMENTARY WATER WORKS	5.6	4.7	10.3	8.4%	8769	2635	3485	2848	0	0
INTEREST DURING CONSTRUCTION	2.7	5.6	8.3	6.8%	6732	109	827	2430	3287	0
TOTAL FINANCING REQUIREMENTS	69.6	52.7	122.3	100.0%	100039	5462	34982	36834	22761	0
FINANCED BY:										
[A] FOR NRS:										
PROPOSED IBRD LOAN	0.0	15.0	15.0	12.3%	12130	0	2076	4704	3758	1592
EQUITY CONTRIBUTIONS 2]	22.9	3.3	26.2	21.4%	21525	128	10980	9680	2329	-1592
[B] FOR TWS:										
PROPOSED IBRD LOAN	0.0	23.0	23.0	18.8%	18483	0	3155	5758	6100	3469
BONDS	19.0	0.0	19.0	15.5%	15500	1500	5000	5000	4000	0
GOVERNMENT LOANS	8.2	0.0	8.2	6.7%	6770	900	3430	2080	380	0
INTERNAL CASH GENERATION 2]	13.6	6.2	19.8	16.2%	16183	231	6853	6576	6193	-3469
[C] FOR COMPLEMENTARY WATER WORKS										
ADB COFINANCING	0.0	4.0	4.0	3.3%	3400	850	1020	1360	170	0
CITIES's BONDS & INTERNAL CASH GENERATION	5.9	1.2	7.1	5.8%	6049	1853	2888	1697	-170	0
TOTAL FINANCING	69.6	52.7	122.3	100.0%	100039	5462	34982	36834	22761	0

1] Due to rounding the last digit in totals may appears different from the sum of digits.
2] The lag between project investments and Bank disbursements reverses in 1989, when the investment is completed.

TABLE 3.3: PROCUREMENT OVERVIEW - COSTS AND BANK FINANCING a]

$ Million

PROJECT ITEM:	PROCUREMENT METHOD ICB	LCB	OTHER b]	TOTAL COST
(A) NAMGANG REGIONAL SYSTEM				
Civil Works	15.7			15.7
	(3.0)			(3.0)
Materials & Equipment	16.3		1.0	17.3
	(11.0)		(0.5)	(11.5)
Engineering and TA			1.5	1.5
			(0.5)	(0.5)
	32.0	0.0	2.5	34.5
Land & Taxes				5.0
SUBTOTAL	32.0	0.0	2.5	39.5
	(14.0)	0.0	(1.0)	(15.0)
(B) TAEGU WATER SYSTEM:				
Civil Works	20.3	13.8	1.0	35.1
	(3.5)	(2.2)	(0.3)	(6.0)
Materials & Equipment	14.1	5.0	2.0	21.1
	(11.5)	(3.6)	(1.4)	(16.5)
Engineering and TA			1.6	1.6
			(0.5)	(0.5)
	34.4	18.8	4.6	57.8
Land & Taxes				6.5
SUBTOTAL	34.4	18.8	4.6	64.3
	(15.0)	(5.8)	(2.2)	(23.0)
(C) TOTAL				
Civil Works	36.0	13.8	1.0	50.8
	(6.5)	(2.2)	(0.3)	(9.0)
Materials & Equipment	30.4	5.0	3.0	38.4
	(22.5)	(3.6)	(1.9)	(28.0)
Engineering and TA	0.0	0.0	3.1	3.1
	0.0	0.0	(1.0)	(1.0)
	66.4	18.8	7.1	92.3
Land & Taxes				11.5
TOTAL	66.4	18.8	7.1	103.8
	(29.0)	(5.8)	(3.2)	(38.0)

a] Figures in parentheses are respective amounts financed by Bank loan. The table excludes the complementary water works in the NRS municipalities ($ 10.3 million), which would be procured following ADB's and local procurement guilines.

b] Prudent local shopping and negotiated contracts.

Procurement

3.07 Procurement arrangements for the project are summarized in Table 3.3. The contract packaging ensures efficient project implementation. The NRS complementary distribution works would be procured following ADB and local procurement guidelines. The main civil works and the bulk of the materials and equipment, aggregating about $66 million will be procured through International Competitive Bidding (ICB) following Bank guidelines. A preference margin in accordance with Bank guidelines would be granted for domestic goods at bid evaluation. TWS civil works contracts, under $2 million each, and aggregating about $14 million, and pipe materials contracts, under $0.5 million each, and aggregating about $5 million, would be procured through Local Competitive Bidding (LCB) procedures which have been reviewed and are satisfactory to the Bank. One civil works contract for intake works estimated at about $1 million and a control equipment contract estimated at about $2 million would be negotiated with the respective contractors who completed the first stage of these works for the TWS in 1984, under ICB contracts financed under Loan 2072-KO. This would be economical and ensure compatibility of works and equipment and validity of guarantees. A provision has been made that urgently needed goods including specialized leak detection equipment as agreed with the Bank, estimated to cost not more that $0.25 million per contract and aggregating not more than $1.0 million may be procured through prudent shopping. Due to the experienced and competitive local construction industry, foreign contractors are not expected to be interested in bidding for civil works contracts.

3.08 Prior Bank review would be needed for civil works contracts over $2 million and goods contracts over $0.25 million, which include about 60% of the value of all contracts. This is adequate since both implementing agencies are well experienced in Bank financed procurement. Advance contracting has been included at Government's risk for consultant services for about $2 million. Consultants for project supervision would be selected in accordance with Bank guidelines.

Disbursements

3.09 Proceeds of the Bank loan would be disbursed against: (a) 35% of civil works contracts; (b) 100% of the foreign expenditures and 100% of ex-factory local expenditures for equipment and materials; and (c) 50% of the cost of consulting services. Disbursements under contracts for equipment and materials costing $250,000 equivalent or less each would be made on the basis of statements of expenditure. A Special Account of $1.5 million would be established in each subproject to facilitate loan disbursements against eligible expenditures under each of the two subprojects. The closing date of the loan would be June 30, 1990.

Project Implementation

3.10 The project is in an advanced stage of preparation. General Procurement Notices for both subprojects have appeared in the

"Development Forum" and prequalification is underway. Detailed engineering would be completed by August 1985, and the first contract would be awarded by December 1985 (Annex 5). TWB plans to appoint consultants for assisting in supervision of the TWS before the award of the first contract. This was confirmed at negotiations. The project would be constructed between December 1985 and December 1988 (Annex 5). The implementation schedule is realistic based on the experience with similar projects in the sector, particularly the First Water Supply Project, where Taegu and three other cities commissioned their water works in less than 36 months, and the other city, Kwangju, completed its works, including a large dam, in under 42 months. Disbursements of the Bank loan are expected to take four and a half years, somewhat faster than the country disbursement profile. The estimated disbursements are shown in Annex 6.

3.11 The NRS would be implemented by MOC and supervised by their Pusan Regional Construction and Management Agency (RCMA), with the support of consultants. This office would designate four field engineers under the Director of its Rivers' Improvement Division to be resident at the project sites. MOC plans to retain, for supervision of the NRS, the consultants engaged in the design of this subproject. The appointment of consultants for assisting in supervision of the NRS is a condition of disbursements for this component. MOC's Water and Sewerage Bureau would provide coordination from Seoul as well as liaison with the Bank. MOHA would review the organization of water and sewerage services in Taegu City. ISWACO would be responsible for taking over the project on completion and for the implementation of the tariff studies with the assistance of consultants. TWB with the support of consultants would implement the TWS subproject. Both MOC and TWB have adequate experience in implementing foreign assisted projects. Charts 1 to 3 show these implementing arrangements. Land acquisition and compensation for the NRS subproject involving some 17 ha is proceeding satisfactorily. For the TWS subproject, most of the necessary land is already under City ownership. The responsibility for land acquisition and compensation, engineering, bid evaluation and supervision would rest with the respective Project Offices. Bidding and contract awards would be the responsibility of the Office of Supply (OSROK), the main Government procurement agency, which has wide experience in both ICB and LCB for foreign assisted projects. For the NRS, the complementary distribution works for the two beneficiary cities are being implemented by MOHA and the cities with the support of consultants. The complementary distribution works required for the other eleven municipalities in the NRS would be financed and implemented by the respective county offices. MOC's Water and Sewerage Division and MOHA's Local Finance Division would coordinate, arrange financing and provide support for these programs.

Operation and Maintenance

3.12 The NRS facilities will be transferred to ISWACO for operation and maintenance (para. 4.03). ISWACO presently satisfactorily operates and maintains nine other bulk water supply systems and has wide experience in this field. The TWB would be responsible for the operation and maintenance of the TWS facilities constructed under the project.

Environmental Aspects

3.13 The project would improve health and environmental living conditions of the population through the provision of safe water. However, while increasing water supply the project would also increase the volume of waste water. Government is now starting to address this problem and is giving priority to the planning and financing of a country-wide program to provide improved collector and interceptor sewers and treatment facilities for urban areas. Starting in July 1985, the cities will collect sewerage tariffs, amounting to up to 50% of their water tariffs, to finance improvements to waste water collection and disposal systems. These improvement programs, when completed, would help improve sanitation. Generally, municipalities in Korea maintain efficient sanitation services like garbage collection and disposal, street cleaning, septic tank and night soil collection and disposal and maintenance of drains and water courses. Residents are very conscious of the environment and maintain neighborhoods and premises clean. These factors, particularly in the project municipalities, result in better neighborhood environmental conditions than in comparable municipalities in most developing countries.

IV. THE BORROWER AND EXECUTING AGENCIES

The Borrower

4.01 The borrower will be the Government which will relend the Bank loan to Taegu City for the TWS on the same terms and conditions as the Bank loan plus a 0.05% p.a. handling charge. After completion of the NRS, its assets and the corresponding portion of the Bank loan would be transferred to ISWACO on the same terms and conditions as the Bank loan plus a 0.05% p.a. handling charge. The foreign exchange risk would be borne by ISWACO and Taegu City. A Project Agreement covering operation and maintenance and financial covenants would be executed with ISWACO. Government would enter into a Subsidiary Loan Agreement with Taegu City to onlend the Bank loan component for the TWS. Signing of this Subsidiary Loan Agreement is a condition for effectiveness.

Namgang Regional System (NRS)

4.02 Implementing Agency: Ministry of Construction. The NRS would be implemented by MOC (para. 3.11). After completion of construction its assets and liabilities would be transferred to ISWACO. MOC's Pusan RCMA would be designated as the Project Office. The Pusan RCMA is managed by a Director General and has the following Divisions: General Services, Roads, Rivers' Improvement, Laboratory, and Special Construction Offices. An office under the Director of the Rivers' Improvement Division would be designated for supervision and construction management. MOC confirmed during negotiations that a site office, initially staffed by at least one field engineer, would be established by December 1, 1985. MOC's accounting procedures are adequate. MOC's Accounts Department would be responsible for project cost accounting, with internal audit from MOC's Inspector General's Office, and external audit by the Board of Audit. Assurances were obtained that within six months of the end of each fiscal year MOC would send to the Bank a summary of the project cost accounts, as audited by independent auditors acceptable to the Bank.

4.03 Operating Agency: ISWACO. ISWACO would be responsible for the operation, maintenance and debt payment for the NRS. Assurances were obtained that a Transfer and Operations Agreement for the NRS, a draft of which would be presented to the Bank for comments by December 31, 1987, would be signed with ISWACO prior to the completion of the NRS. ISWACO is satisfactorily operating nine other regional systems (Chart 2), which would provide bulk water to some 60 municipalities by 1988. ISWACO is also the borrower for three previous Bank loans being executed satisfactorily: The Chungju Multipurpose Dam (Loan 1666-KO), the Second Water Supply Project started in 1984, and the Metropolitan Region Water Supply Project approved in February 1985.

4.04 ISWACO was established on February 1, 1974, pursuant to the law for the promotion of industrial sites and water resources development, to: (a) undertake the development of industrial sites and special areas; (b) construct, operate and maintain multipurpose dams for water supply, irrigation, flood control and power generation; and (c) operate regional water supply systems which provide raw or treated bulk water for municipal and industrial use. ISWACO has planned and

constructed nine industrial estates and new cities and six multipurpose dams, and operates nine regional water supply systems. The largest dams under construction are Hapcheon (financed by OECF), the Nakdong Barrage (financed by Loan 2350-KO), and the Juam and Imha Dams (also financed by OECF). Feasibility studies are being prepared for five other multipurpose dams which are expected to be built within the next ten years.

4.05 ISWACO is managed by a Board of Directors, which includes ISWACO's President, a representative of MOC and the Manager of the Government Invested Corporations. ISWACO's President is appointed by the President of Korea. ISWACO has a Vice-president, who is also responsible for planning, and four other Directors (Administration, Industrial Sites, Water Resources and Public Utilities) and an Auditor (Chart 2). The directors are appointed by MOC for a period of three years, and the Auditor for a two-year period. ISWACO has developed into a large and competent organization with 15 departments, 18 local offices and 1,278 employees, 42% of whom are in Taejeon at headquarters and the others in local offices and at construction sites. Many of ISWACO's 500 engineers have been trained abroad, and, working together with foreign consultants, have acquired considerable experience in the design, construction and maintenance of large projects. ISWACO has insurance against fire as well as for vehicles, and is self-insured against other risks. ISWACO's financial statements have been audited satisfactorily by independent private auditors. Assurances were obtained during negotiations that ISWACO's financial statements would continue to be independently audited, and that a copy of the auditor's report would be sent to the Bank by July 1, six months after the end of each fiscal year.

4.06 ISWACO's management is efficient, with administrative expenses representing less than 5% of operational expenses. In May 1984, the Government enacted the Public Enterprise Reform Law, providing more autonomy to public enterprises and creating mechanisms to monitor their efficiency, in particular an annual evaluation used to rank all public enterprises. This government ranking is then used to award bonuses of up to six months' salary to all employees of the best enterprises. ISWACO's management has, as a result, been very receptive to ideas to improve itself, and under the Metropolitan Region Water Supply Project is undertaking a study (to be completed by December 31, 1986) to strengthen its financial management and management information systems.

4.07 ISWACO's operations are well run, with sophisticated telemetering and control systems, metering and regular maintenance programs. Statistical information is adequate, water services are reliable, unaccounted-for water is less than 5%, and accounts receivable are less than 30 days. Accounting and payrolls are computerized, and under the Second Water Supply Project, microcomputers have been purchased and are being used for financial projections and planning. To ensure proper maintenance of the NRS, assurances were obtained from ISWACO during negotiations that it would prepare a maintenance program for the NRS and send a copy to the Bank for comments not later than December 31, 1987.

Taegu Water System (TWS)

4.08 Implementing and Operating Agency: Taegu Water Bureau (TWB). The TWB would be responsible for the construction, operation and maintenance of the TWS. TWB has an experienced staff and has satisfactorily implemented previous development projects, including its component of the the First Water Supply Project. TWB is a semi-autonomous department within the City, with autonomous budget and resources, and reports to the Mayor. TWB's budget is about one quarter of the City's budget.

4.09 The TWB is managed by a Director General, and has three main divisions responsible for: (a) Business: accounting, planning, budgeting and cash management of TWB; (b) Engineering: planning, design and construction supervision (with the support of consultants) of waterworks expansions and local and international procurement (with the support of OSROK); and (c) Maintenance and Supply: operation and maintenance of treatment plants and distribution systems, construction of small distribution networks and house connections. Under this last division six Service Offices (one for each district), are responsible for metering, maintenance and control of the distribution system in each district. The TWB's organization is satisfactory and has competent and motivated staff (Chart 3). The total staff is 764 persons, or 9% of total city staff. Staff efficiency is high - 3.7 employees per thousand water connections - which is better than in most developing countries. Other indicators of efficiency are also good: water connections are fully metered, meters are well maintained, and meter maintenance shops are adequate. Collections are made through commercial banks and branch offices. Collection procedures are tight and strictly enforced, and accounts receivable at the end of each month are just two weeks of billing.

4.10 Water supply accounts, revenues and expenses are kept separate from the city accounts. The system of accounts for all WBs in Korea was recently updated by MOHA, reviewed by the Bank, and is satisfactory. Accounting information is reliable and timely. Presently only billing and payroll are computerized, but under the Second Water Supply Project computer hardware and software is being tested and developed to computerize accounting, finances, inventories, etc., and to provide a Management Information System for all WBs including Taegu City. External auditors have been submitting timely and satisfactory audit reports. Assurances were obtained during negotiations that the project cost accounts for the TWS and the TWB's financial statements would continue to be independently audited, and that a copy of the auditor's report would be sent to the Bank by July 1, six months after the end of each fiscal year.

V. FINANCIAL ANALYSIS

A. ISWACO'S Past and Present Financial Performance

5.01 Upon completion of the project, ISWACO would own and operate the NRS and another ten regional water supply systems. ISWACO is a public enterprise owned by the Government (95%) and the Korea Development Bank (5%). Its authorized capital is W 500 billion, fully paid as of December 31, 1984. ISWACO has been growing rapidly and its fixed assets increased almost four times between 1980 and 1983. ISWACO's financial performance during the last five years has been satisfactory, with positive and rapidly increasing net income (averaging 2% of its equity), a current ratio of 1.4, and a debt/(debt plus equity) ratio of 50%. However, its operating ratio is higher than 92%, primarily due to the effect of the Industrial Sites Division, which has an operating ratio of 100%. Consolidated financial statements for ISWACO are shown in Annex 9. The construction of new industrial sites and cities was the main activity of ISWACO some years ago. After construction, these industrial sites, together with related loan obligations, are sold at cost. Recently, however, the Korea Land Development Corporation (KLDC) and some cities are undertaking industrial site development, and ISWACO's revenues and expenditures on this operation have halved between 1979 and 1983. Given the balancing of revenues and expenditures of the Industrial Sites Division, and its decreasing activities, ISWACO's future finances would mainly depend on its two other operations, the Water and Dams Divisions. The Water Division sells water in bulk to many municipalities (more than 60 by 1988) and industrial zones, and the Dams Division sells energy to the Korea Electric Power Company (KEPCO) and collects water rights charges from cities using water from rivers regulated by ISWACO. The financial analysis for ISWACO is therefore centered on these two Divisions.

5.02 In 1984, the Water Division accounted for only 35% of ISWACO's revenues, but its net revenues were two thirds of ISWACO's total net revenues. The financial performance of this Division is satisfactory (see Annex 7), and provides substantial cash contributions for ISWACO's development investments. ISWACO's national bulk water tariffs include a fixed charge for the basic contracted quantity, a charge per unit of volume used, and a surcharge for volume used in excess of the contracted quantity. The present tariffs average W 32 per ton of raw water and W 74 per ton of treated water. The pricing policy and the criteria to set these tariffs, including the appropriate ratio between fixed and excess demand charges and their specific application to the proposed NRS, are being studied under the project (para. 1.08 a).

5.03 The Dams Division operates six dams (Andong, Soyang, Taechong, Nam, Seonjin and Chungju), and three additional dams and the Nakdong Barrage are under construction. About 84% of its total revenues are from the sale of bulk power to KEPCO. The Chungju Dam would increase the power generated by ISWACO by 138% between 1984 and 1986. The other 16% of the Division's revenues in 1984 were from water rights charges, collected from municipalities and industries which use water from rivers regulated by ISWACO. Charges for these services

are based on the economic allocation of the cost of each dam to water, power, irrigation, flood control, etc., in proportion to their respective benefits or alternative costs. ISWACO's efforts to collect charges and recover a portion (30%) of the cost allocated to irrigation have not been successful. These charges are opposed by farmers with support from the Ministry of Agriculture, which wants to reduce the cost of food production. Nevertheless, ISWACO is planning to increase the irrigated area paying charges (around $25 per ha per year) from 190 ha in 1983 to 8,500 ha by 1988, but this would still only represent a small fraction of the land irrigated from rivers regulated by ISWACO. ISWACO's power revenues depend largely on weather conditions. During the 1982 drought, sales of hydro-generated power dropped from 988 to 614 GWh, resulting in a deficit of W 1,662 million in this Division. The present financial position of the Division is, however, satisfactory, as shown by its financial indicators (Annex 8, Table 5). Cash operating expenses, including taxes, represent a low and declining percentage (34%) of its revenues, and most of the Division's revenues are used for capital expenditures.

5.04 ISWACO has made considerable efforts to comply with the rate of return covenant under previous projects (Loans 2350-KO and 2491-KO). The doubling of the value of its fixed assets, which were revalued in 1984, and increased operating costs due to price increases for power and water rights made compliance very difficult. Between 1982 and 1984, ISWACO's power charges were increased from W13.8/Kwh to W23.7/Kwh (58% in real terms), and water rights charges were increased from W1.9/ton to W 3.7/ton (78% in real terms). Although Government's policy is to stabilize prices and control inflation, ISWACO's water charges were increased 10% in January 1985, which would allow compliance with the 4% rate of return covenant in 1985. ISWACO had to undertake the operation of the Geumgang Regional System, where demand is likely to remain at only a small fraction of its water production capacity for many years. It would be inequitable to penalize water users in other regions to compensate for the poor performance of this system. Therefore, for purposes of the rate of return covenant, the financial projections include the full costs of operation and depreciation of this system, but exclude its fixed assets from the rate base up to 1989. The power charges payable by KEPCO for Chungju Dam are being studied by consultants. Their preliminary recommendation of W35/Kwh would allow compliance with the rate of return covenant for the Dams Division in 1985 and 1986. It was confirmed during negotiations that the tariff study for Chungju power tariffs would be completed before end of September 1985, and that the approved tariff would be implemented by the end of 1985 and would be effective retroactively from the start of power generation of this dam by mid-1985.

ISWACO's Future Financial Performance

5.05 Assurances were obtained during negotiations that ISWACO's Water and Dams Divisions would achieve a minimum rate of return on revalued fixed assets of 5% from 1986. This rate, already included in the Metropolitan Region Water Supply Project, provides a satisfactory financial performance and is reasonable in view of: (a) for the Dams Division: the lumpiness of the investments in dams, and the provision

of services whose costs are not fully recoverable from users (such as charges for water taken from the rivers for irrigation and flood control expenses); and (b) for the Water Division: the provision of satisfactory water services to the poorest regions at a reasonable price. This rate of return would allow ISWACO to meet operational and and debt service expenses, and internally finance about 15% of the large planned investments ($1,050 million) in thse Divisions between 1984 and 1988. These investments would more than double the net fixed assets of these Divisions in 1983. Compliance with this covenant is feasible but would require considerable efforts. For the Dams' Division, power charges would have to be further increased by 50% in real terms between 1984 and 1988, and the charges for water rights increased by 60% in real terms in the same period. For the Water Division, tariffs would have to be adjusted by about 10% in real terms between 1984 and 1988. ISWACO's power charges are negotiated with KEPCO in consultation with EPB and the Ministry of Energy and its water charges are approved by MOC in consultation with EPB.

5.06 These rates of return would be based on fully revalued assets. In accordance with Korean law, fixed assets can be revalued when their estimated value exceeds 25% of the book value. Assets revaluation doubled the assets of the Dams Division in 1984. The fixed assets of the Water Division are relatively new (the oldest was completed in 1980), and since inflation has been low in the last few years their formal revaluation would only be completed by end-1985. Nonetheless, the financial projections use the estimated revalued assets for this Division. Assurances were also obtained during negotiations that for rate analysis, the value of ISWACO's fixed assets would be adjusted annually until the next formal revaluation, using 85% of the annual increase in the wholesale price index as a proxy for the increase in value of these assets.

5.07 Under the proposed rate of return covenant (para. 5.05), the financial position of the Dams Division would be satisfactory (Annex 8): its working ratio would average 12%, its debt service ratio would average 1.7, and its ratio of debt/(debt plus equity) would be below 36%. After 1988, annual investments of about $40 million would be internally financed, and additional cash would be available to contribute to the construction of the other dams planned for the 1990s. The Water Division would also have a satisfactory financial performance (Annex 7), with its working ratio averaging 64%, its debt service ratio exceeding 1.8, and the ratio of debt/(debt plus equity) being below 18%. After project completion, this Division would rapidly accumulate cash and be able to provide a substantial internal contribution to future water works. Financial highlights for the Water and Dams Divisions are presented in Tables 5.1 and 5.2. Additional investments and their financing could affect ISWACO's financial position. Assurances were obtained during negotiations that ISWACO would not incur any additional long-term debt without prior Bank concurrence, unless its debt service coverage exceeds 1.3 in any calendar year.

TABLE 5.1: FINANCIAL HIGHLIGHTS - ISWACO'S WATER DIVISION (Annex 7)

	1982	1984	1986	1988	1990
Raw Water Sold - Million Ton	919	1120	1228	1263	1561
Treated Water Sold - Million Ton	28	56	93	167	449
Raw Water Tariff - W per Ton	33	32	37	42	43
Treated Water Tariff - W per Ton	75	74	86	96	98
Total Revenues (Million W)	32098	39814	53530	68692	110518
Operational Expenses (Million W)	20379	27412	35013	43900	65678
Depreciation (Million W)	5533	6064	8615	11338	17866
Net Income (Million W)	5154	5160	6517	9056	14472
% Working Ratio	63.5%	68.9%	65.4%	63.9%	59.4%
% Rate of Return (on Revalued Assets)	3.4%	3.3%	5.0%	5.0%	5.0%
Capital Expenditures (Million W)	240	2740	75505	53191	2500
Debt Service Coverage (times)	5.5	5.2	3.7	3.8	2.2
% Debt on Debt plus Equity	8%	7%	14%	18%	13%

TABLE 5.2 FINANCIAL HIGHLIGHTS - ISWACO'S DAMS DIVISION (Annex 8)

	1982	1984	1986	1988	1990
Power Sold (GWH)	614	686	1519	1747	1743
Power Rate W/Kwh	13.8	23.6	34.6	41.8	53.3
Water Rights Rate W/ton	1.9	4.2	5.5	6.7	8.7
Total Revenue (Million W)	10405	21614	60348	85984	113399
Operational Expenses (Million W)	4767	4668	6744	9832	12539
Depreciation (Million W)	5053	7983	19653	28475	38549
Net Income (Million W)	-2166	6603	17959	21709	37816
% Working Ratio	45.8%	21.6%	11.2%	11.4%	11.1%
% Rate of Return on Revalued Assets	0.3%	3.3%	5.0%	5.0%	5.0%
Capital Expenditures (Million W)	169969	148354	173395	71106	21714
% Capital Expend. to net Fixed Assets	97%	54%	23%	6%	2%
Debt Service Ratio	0.8	1.1	1.7	1.6	1.6
% Debt on Debt plus Equity	37%	33%	35%	27%	19%

TABLE 5.3 TAEGU WATER BUREAU - FINANCIAL HIGHLIGHTS (Annex 10)

	1982	1984	1986	1988	1990
Water Sold - Million Ton	85.2	110.9	131.4	159.2	188.7
Average Water Tariff W/Ton	153.2	193.8	218.6	234.1	245.7
Total Revenues (Million W)	21734	26535	33991	43305	53997
Operational Expenses (Million W)	16432	15395	18038	21797	26729
Depreciation (Million W)	1195	2487	4738	6273	8356
Net Income (Million W)	3003	2982	6713	9858	14478
% Working Ratio	75.6%	58.0%	53.1%	50.3%	49.5%
% Rate of Return on Revalued Assets	6.5%	8.9%	8.0%	8.4%	8.0%
Capital Expenditures (Million W)	17661	24610	20683	20429	11171
Debt Service Ratio	8.0	2.0	1.8	1.6	2.1
% Debt on Debt Plus Equity	27%	50%	39%	35%	27%

B TAEGU WATER BUREAU (TWB)

Past and Present Financial Performance

5.08 The TWB is a semi-autonomous bureau of Taegu City and is responsible for the construction, operation and maintenance of water works. It has an independent budget with autonomy over the investments financed from its internal resources. The TWB is a well managed water utility. Internal cash generation by the TWB financed more than 30% of capital expenditures during the First Water Supply Project (1982-1984), in excess of the 20% required under that loan. Although Government set strict guidelines to control inflation between 1982 and 1984, TWB's water tariffs were increased 15% in real terms during that period. Costs are well controlled and personnel expenses are only one quarter of the total expenses. However, unaccounted-for water, which averaged 34% in 1982/83, increased to 38% in 1984 due to improved water pressures. This would be corrected through a leak detection and network rehabilitation program being implemented with the support of consultants (para. 2.11). The TWB's financial performance between 1982 and 1984 has been good: the rate of return on partially revalued assets averaged 7.7%, the operating ratio was 75%, the debt service ratio exceeded 2, accounts receivable were less than 10 days, and the ratio of debt/(debt plus equity) has been less than 50%. The TWB accounts somewhat underestimate the real income, because of the Korean practice of charging the revenues and expenditures for house connections to the income statement, instead of depreciating the house connections over their useful life. This practice is preferred because of simplicity, and because these revenues and expenditures cancel each other out.

5.09 Water tariffs are satisfactory. In fact, since a large percentage of the water works are financed by short-term (five year) bonds, the tariffs required for financial viability are above the long-run marginal cost. Requests for tariff increases are submitted to MCBA, and are approved within general guidelines for price increases set by EPB. The average tariff in 1984 was W 194 ($0.24) per ton. Water charges varied for each category. Average residential charges are only 73% of average charges. Other users pay higher charges, amounting to 162% of average charges for commercial and industrial users, and 128% for public and other users. The tariff structure is progressive, penalizing wasteful use of water and subsidizing low income consumers. Consumption charges for commercial or industrial users are 2.5 to 5 times the minimum charges for low income users. Financial highlights of the TWB are presented in Table 5.3.

Future Financial Performance

5.10 TWB's tariffs should cover operation, maintenance and debt service, and provide substantial internal contributions to finance its water works investments. This requires a rate of return on revalued fixed assets of 8% p.a, which can be achieved by tariffs only 5% higher in real terms than the present tariff. The above rate of return would provide a satisfactory financial position not only during the construction period, when TWB would internally finance up to 43% of its total investment, but also for the foreseeable future (Annex

10). This would also result in an average working ratio of 52%, a debt service ratio above 1.4, and a ratio of debt/(debt plus equity) below 41%. Assurances were obtained during negotiations that starting in 1986 water charges and other operational revenues would be sufficient to cover operation, maintenance, and depreciation and achieve a rate of return not lower than 8%. The TWB's fixed assets were revalued satisfactorily at the end of 1984 in accordance with Korean law. Agreement was also reached during negotiations that for rate analysis, the value of TWB's fixed assets would be revalued as explained in para. 5.06.

Reporting Requirements - Monitoring Indicators

5.11 In order to satisfactorily monitor the investment programs and financial plans, assurances were obtained during negotiations that:

(a) ISWACO would send to the Bank, not later than February 28 and August 31 of each year, a Management Information Report, including data on water demand and revenues, and the monitoring indicators presented in Table 5 of Annexes 7 and 8, and the status of compliance with loan covenants. The August 31 report would also include updated five-year projections (income, flow of funds and balance statements) for its Water and Dams Divisions;

(b) MOC would send to the Bank not later than August 31 and February 28 of each year, semiannual reports on the cost (Annex 4A) and updated execution schedule of the NRS (Annex 5);

(c) TWB would send to the Bank, not later than August 31 and February 28 of each year, a Management Information Report, including the project cost (Annex 4B), the updated execution schedule (Annex 5) and monitoring indicators (Annex 10, Table 5), and the status of compliance with loan covenants; and

(d) MOC and TWB would prepare for the NRS and TWS respectively, a Project Completion Report satisfactory to the Bank, not later than six months after the loan closing date.

VI. PROJECT JUSTIFICATION

Introduction

6.01 The proposed NRS meets urgent water needs for thirteen municipalities, including two cities and eleven towns and villages, in Kyeongnam Province. Although the project region has considerable economic potential, its development and population growth rates are well below those of other regions, mainly because of the scarcity of water. The project also includes the expansion of water services for Taegu, the third largest city in Korea, where rapid population and industrial growth would overextend the water supply by 1988. The project would solve these problems and provide the water needed for the development of both project areas.

Project Benefits

6.02 Upon completion of the NRS, about 140,000 persons who are already served would be free of water rationing and low pressures. In addition, the project would meet the growing water needs for commercial and industrial development, and nine of the municipalities would have a public water system for the first time. The NRS provides only treated water in bulk to the municipalities. The two main cities in the NRS, Samcheonpo and Chungmu, are already expanding their distribution and house connections systems with ADB financing. Government provided assurances that similar distribution works would be completed in the smaller towns by 1988 (para. 3.04).

6.03 The TWS would improve service and reduce the unaccounted-for water and operational expenses for the population already served in Taegu City (about 1.9 million persons), and would serve about 400,000 additional persons by 1991 and 780,000 persons by 1995. The TWS would provide water to unserved areas of the city and increase coverage from 94% in 1984 to 98% by 1991, when practically everyone would enjoy good water service in terms of quantity, quality and reliability.

6.04 The project would also foster sector reforms through the continuation of the sector policy dialogue (paras. 1.09 and 1.11). A benefit of the project would be the establishment of an integrated and more efficient system of treated water for the NRS, and its reduction in cost by using revised demand projections. Tariff studies are under way, under Terms of Reference agreed with the Bank, to analyze national tariff policies and levels for bulk water, and apply the recommended policies to the NRS. The organization of water and sewerage services in Taegu City would also be reviewed under the project. The conclusions of this review would be applicable to other cities, and would, when implemented result in better planning and coordination of the investments for both services, lower government contributions and improved sanitation and environmental conditions.

Poverty Impact

6.05 The population served by house connections in the NRS would increase from 55% in 1983 to 75% in 1988 and 82% by 1991 (Annex 3A, Table 2). The NRS would also provide water for the first time to an additional 120,000 persons by 1991 and 175,000 persons by 1996. Most of the population without water, or with a rationed supply, is of low income, and the new neighborhoods to be served are predominantly low-income. In this region, the population in relative poverty 1] averages 24% compared to 18% for the country as a whole. It is expected that about 65% of the urban poor in the project area (about 50,000 persons) would have house connections by 1991, compared with 17% now. In Taegu about 150,000 persons in relative poverty would be served by 1991, about one third of the incremental population benefited by the TWS. Without the project investments, the rapid population growth of Taegu would reduce the percentage of population served to below 80% by 1991.

Least Cost Solution

6.06 The water demand and the selection of the least cost solution was an issue during the preparation of the NRS (para. 2.04). The alternative selected, using the existing Namgang Reservoir as the source, is considerably less expensive than the other three alternatives studied (Annex 11). The routes selected for the pipelines are also the least expensive. A water treatment plant (75,000 tpd) in the first stage would be followed by an expansion of capacity to 115,000 tpd by 1992. The proposed investments for the TWS are also least cost, other alternatives would have been at least twice as expensive.

Rate of Return

6.07 The Economic Rate of Return (ERR) for the project, based on existing tariffs and the water benefits including increased value of benefitting properties, is estimated at 13% for the NRS and 18% for the TWS, with a weighted average of 16% (Table 6.1 and Annex 11). Sensitivity analysis shows that an increase in investment costs by 10%, combined with a decrease in benefits by 10%, would reduce the ERR to 13%. The optimal design horizon for the pipelines is the year 2001, because of economies of scale. This makes the investment lumpy and reduces the rate of return. Because of this, and since bulk water tariffs are the same throughout the country, regardless of the cost of water production in each regional system, the Incremental Financial Rate of Return (IFRR) for the NRS, based only on ISWACO tariffs, is 2%. This highlights the need for the proposed tariff study (para. 1.08 (a)). The IFRR for the NRS, using retail water tariffs and the distribution investments required to provide water to the population, is 6% (Annex 11 A, Table 3). This is because present retail water tariffs do not cover the full cost of operation, since there is limited willingness to pay for water services which presently are rationed, unreliable and of unsatisfactory quality. However, the NRS

1] Persons with incomes below one third of the country's average per capita income.

is the only economic water supply source available for the municipalities in the project area and is essential for the region's development. For the TWS, the ERR, based on existing tariffs, is 18%. Sensitivity analysis shows that an increase of investments by 10% combined with a 10% reduction in benefits reduces the ERR to 15%. The above rates of return exclude other important benefits which are difficult to quantify (such as the improvement of the living standards of the population already connected, the consumer surplus, and the health and general welfare benefits brought on by safe and reliable water supply).

TABLE 6.1 ECONOMIC RATE OF RETURN

	% RATE OF RETURN			
	Base Case	Investment 10% Higher	Benefits 10% Lower	Investment +10% Benefits - 10%
NAMGANG REGIONAL SYSTEM	13	11	10	9
TAEGU WATER SYSTEM	18	17	16	15
TOTAL PROJECT	16	15	14	13

Marginal Cost

6.08 The marginal cost of bulk treated water in the NRS is W 169 per ton ($0.20 per cubic meter) assuming a discount rate of 10% (Annex 11A, Table 2). This is twice the present nationwide tariffs for treated water. There are some valid arguments for not charging the full marginal cost in the NRS region, mainly because of the relative poverty and the need to promote development of the region. Nonetheless, water charges should provide a better indication of the cost of water. The tariff study (para. 1.08 (a)), would provide recommendations on the level of charges to be applied to the NRS based on economic, financial and social considerations. Since the volume of water sold in this region would be less than 2% of the water sold by ISWACO, the financial impact of this system on the overall financial position of ISWACO is negligible. By contrast, the TWS's marginal cost of W 148 per ton is 26% below the present average water tariff. For TWB, the tariffs required for financial reasons are higher than the marginal cost because of the large percentage of short-term financing (bonds) repayable in five years, while the useful life of the investments is 30 or more years.

Affordability

6.09 Present water rates are affordable both for the NRS and the TWS consumers. For the NRS municipalities, retail water charges represent less than 1% of the average disposable income. In the TWS, water consumption is higher, and average water charges are about 3% of the average income. However, water tariffs in all cities are progressive, subsidizing low income consumers, while excessive consumption is charged at rates 3 to 5 times the rates for minimum

consumption. Therefore in both subprojects, the urban poor, which typically use less than 10 tons of water per month, pay only about W1,300 per month, which is less than 1% of the monthly disposable income at the poverty threshold. The effect of the tariff increases expected during project implementation would be compensated by the expected increases in per capita income, maintaining water readily affordable for the whole population.

Project Risks

6.10 There are no special risks in the project. The implementation schedule is feasible based on previous project experience and the relatively small size of works. However delays may occur, and if so the rate of return would be lower, but nonetheless adequate. In addition, there is the risk that the municipalities may not build the necessary distribution works on time, delaying the project benefits. This has not been a problem in previous projects and Government has provided assurances that complementary works for the NRS would be completed by December 31, 1988 (para. 3.04).

VII. AGREEMENTS REACHED AND RECOMMENDATIONS

7.01 The appointment of consultants for supervision of the NRS is a condition for disbursement for this component (para. 3.11).

7.02 Agreements were reached with Government during loan negotiations that:

(a) the complementary distribution works required in the project municipalities of the NRS would be coordinated by MOC and MOHA and implemented not later than December 31, 1988 (para 3.04);

(b) the cost of the NRS would be audited by independent auditors (para 4.02);

(c) MOC would sent to the Bank semiannual reports and a project completion report for the NRS (para 5.11);

(d) in order to provide adequate water supply for the NRS, MOC would complete a program of land acquisition around the Namgang Reservoir in accordance with a schedule satisfactory to the Bank (para 2.06); and

(e) a Transfer and Operations Agreement for the NRS would be signed with ISWACO prior to completion of the NRS component (para 4.03).

7.03 Agreements were reached with the Government and ISWACO during loan negotiations that:

(a) ISWACO's tariff study, including recommendations for water charges for the NRS, would be presented to the Bank not later than June 30, 1986 (para 1.08 (a));

(b) ISWACO's financial statements would be audited by independent auditors (para. 4.05);

(c) a maintenance program for the NRS would be completed not later than December 31, 1987 (para 4.07);

(d) starting in 1986, ISWACO would achieve rates of return of 5% on revalued fixed assets for its Water and Dam Divisions (paras. 5.05 and 5.06); and

(e) ISWACO would send to the Bank semiannual reports (para 5.11).

7.04 Agreements were reached with the Government and Taegu City during loan negotiations that:

(a) a review of the organization of water and sewerage services in Taegu would be completed by MOHA not later than December 31, 1986 (para 1.08 (e));

(b) TWB's financial statements and the cost of the TWS would be audited by independent auditors (para. 4.10);

(c) starting in 1986 TWB would achieve a rate of return of 8% on revalued assets (para 5.10); and

(d) TWB would sent to the Bank semiannual reports, and a project completion report for the TWS (para 5.11).

7.05 Understandings have been reached and are recorded in the minutes of negotiations on the following:

(a) MOC would give priority to public water supply from the Namgang Reservoir (para 2.06);

(b) the project financing plan (para 3.06);

(c) MOC's Pusan RCMA would be designated as the Project Office for the NRS and a site office, staffed by at least one field engineer, would be established not later than December 1, 1985 (para 4.02); and

(d) the tariff study for the power charges for the Chungju Dam would be completed before end-September 1985, the approved tariff would be implemented by end-1985, and would be effective retroactively from the start of power generation by mid-1985 (para. 5.04).

7.06 The signing of a subsidiary Loan Agreement with Taegu City is a condition for loan effectiveness (para. 4.01).

7.07 With the above agreements and understandings the project is suitable for a Bank loan of $38 million, for a term of 15 years, including a grace period of 3 years at the Bank standard variable interest rate. The borrower would be the Republic of Korea.

KOREA

NAMGANG AND TAEGU WATER SUPPLY PROJECT

EXISTING FACILITIES - WATER SUPPLY AND SANITATION

A. Namgang Regional System (NRS)

1. Namgang Reservoir. The existing reservoir was constructed in 1970 by MOC, and is presently operated by ISWACO, mainly for flood control. It also provides for a power generation by KEPCO of 4300 kW per hour, irrigation water for about 9,800 ha, and about 100,000 tpd public water supply for Chinju and Samcheonpo cities. The reservoir has a catchment area of 2,285 sq km and a surface area of 23.55 sq km at full supply elevation of +39.5 m. It cannot presently be operated at this design elevation due to incomplete land acquisition, presently completed only to elevation +38.0 m (1/10 year high flood level). The main spillway has a design capacity of 2,000 cu m/sec, but discharges of this magnitude would result in some flooding of downstream development in Chinju City. The supplementary gated spillway into Sacheon Bay has a design capacity of 5,460 cu m/sec, but the discharge channel cannot safely pass discharges of this magnitude. As a result of these limitations ISWACO operates the reservoir so as to avoid maximum spillway discharges and high reservoir elevation and has, over the last 10 years, passed the maximum recorded flood (7000 cu m/sec or 1/50 year flood return frequency) with the reservoir at about +37m elevation. The maximum design flood is 10,000 cu m/sec (1/200 year return flood frequency).

2. Both MOC and ISWACO have started studies to identify the best options available to optimize reservoir operations to serve all planned water requirements from the reservoir, including the increase of public water supply from 100,000 tpd in 1986 to about 250,000 tpd in 1991 and 400,000 tpd in 2001. ISWACO studies would also take into account the reduction in water demand for irrigation after the completion of the Nakdong Barrage and the Hapcheon Dam in 1988. These two dams would greatly increase the water availability in the Nakdong River and practically eliminate the need for the Namgang Reservoir for this purpose. ISWACO has also designed a comprehensive hydrological data collection and flood warning system to cover all the major reservoirs being operated by them, including the Namgang Reservoir, and is planning to install this system during 1986 to help improve reservoir operations.

3. Simulation studies indicate that with the reservoir operated as designed, conflicts between water availability for power generation and public water supply would arise by the 1990's. At that time it would be necessary to give public water supply priority on the use of water from the reservoir and compensate KEPCO for loss of power generation. It has been estimated that this loss would amount to only W 1.5 per ton of water supplied. MOC is also carrying out feasibility studies aimed at augmenting the present water resources of the Namgang Reservoir by either raising the crest level of the dam to provide for additional storage or by providing a new storage dam at Hwamyang

upstream of the present reservoir. Either of these options, if implemented, would also resolve any potential conflicts between beneficiaries.

4. In order to ensure adequate water supply for the municipalities in the NRS it has been confirmed (para. 2.06) that (a) MOC would give priority to public water supply in the allocation of water resources from the Namgang Reservoir and, (b) MOC and ISWACO would complete a program of land acquisition (about 340 ha, estimated to cost W 4.8 billion) in accordance with a schedule satisfactory to the Bank. This would allow the operation of the reservoir at its design elevation of 39.5 m. MOC is also planning other measures to increase the water available for the NRS. These include ISWACO's ongoing program to study and optimize reservoir operation under the changed conditions after 1988 (when other dams would enter into operation) and the installation of a reliable hydrological data collection and flood warning system for the reservoir.

5. Water Supply. Public water supply systems are being operated in the two cities (Chungmu and Samcheonpo) and Sacheon and Goseong Eups, with varying degrees of efficiency and adequacy. Gwongdo Myeon is presently building a new system while all other myeons have unreliable, fragmented rural water systems. Present water sources are mainly from the shallow aquifer along the minor valleys of the region. These sources cannot produce adequate supply during the long dry season. The water scarcity is compounded by the water demand for agricultural purposes. The only reliable supply is the 11,000 tpd raw water supply allocated to Samcheonpo City from the Namgang Reservoir through the existing raw water pipeline jointly owned by KEPCO and the City (Map IBRD 18965). This main has a present supply capacity of 20,000 tpd capable of expansion to 30,000 tpd. KEPCO has an allocation of 9,000 tpd from this source for the thermal power station at Samcheonpo and presently uses 4,000 tpd for the first two of the six generating unit to be installed before 1991.

6. The Chungmu City water supply system presently relies on four water sources from infiltration galleries in the shallow acquifer adjacent to local streams. Total design capacity is 15,000 tpd, though normal yield does not exceed 11,000 tpd, with low yields during the prolonged dry season of as little as 2,000 tpd. Three of these sources are outside the City boundary and belong to other municipalities, originating major conflicts for the use of scarce water. Effective production capacity of 11,000 tpd is available in three treatment plants, the oldest of which was commissioned in 1944.

7. Samcheonpo City has two treatment plants, one of 3,000 tpd capacity, drawing water from an infiltration gallery in the Bonghyun River valley, and the other using the previously mentioned 11,000 tpd raw water from the Namgang Reservoir. The first source is unreliable and effective yield is as little as 1,500 tpd and would be abandoned when the project is completed. The Namgang water treatment plant would be gradually phased out by about the year 1996 when the demand for raw water from industry is expected to absorb the full capacity of the existing pipeline.

8. Sacheon Eup draws its raw water from the Sacheon River with a high risk of industrial and agricultural pollution. The leprosarium located upstream of the intake also contributes to pollution of this source. Temporary improvements are planned till the project is completed, when the present facilities will be phased out. Goseong Eup has a treatment plant of 2,000 tpd, but the source is unreliable and would also be phased out on completion of the project.

9. Water supplies are managed by the Water Bureaus in the cities and by a water section within the Construction Bureau in the smaller towns. The WBs are semiautonomous and have an independent budget. Staff is limited and inexperienced.

10. Sanitation. The four municipalities where public water supply is available have combined waste and storm water drainage systems serving about 35% of their area. Premises are served by septic tanks, cesspits or pit latrines. Night soil is collected, treated and used as fertilizer by farmers. The street drains and main water courses which receive most of the waste water from premises discharge untreated wastes into the nearest river or coastal bay. Generally anaerobic polluted conditions prevail in the main water courses during most of the year. The small myeons have lower population densities and less problems to dispose of waste water. The cities and eups maintain efficient garbage and nightsoil collection services and the standards of sanitation are satisfactory.

B. Taegu Water Srpply System (TWS)

11. Water Supply. The main water source for Taegu is the Nakdong River on its western border (Map IBRD 18966R). The Nakdong drains 23,656 sq km or nearly one quarter of the country and provides substantial water resources for major public and industrial water supplies as well as for extensive agricultural requirements in its basin. The Andong Dam constructed in 1974 regulates the river above Taegu, and the Nakdong Barrage now under construction in the estuary, for completion by 1988, would prevent salt water intrusion and allow the use of water presently used to prevent saline intrusion into the river. The Namgang Reservoir, on a downstream tributary also provides regulated flow for downstream users, as would the Hapcheon Dam, now under construction on another tributary. Construction is about to start on the Imha Dam to supplement storage and river control upstream of Taegu. The completion of the Nakdong Barrage in 1988 by itself would assure sufficient year-round water availability in the Nakdong at Taegu, till beyond the year 1996 which is the design horizon of the project.

12. Taegu City presently has a water production capacity of 720,000 tpd from the Nakdong river and can produce another 140,000 tpd from two other local sources. It has four conventional treatment plants, the most modern of which is the 400,000 tpd Dasa Plant, completed in 1984 under the First Water Supply Project (Loan 2072-KO). The distribution network consists of about 100 km of primary and 1,175 km of secondary mains from 75 mm to 2,200 mm diameter. The system includes 20 booster pump stations and 13 service reservoirs of about 66,000 tons capacity, and has about 198,000 service connections

serving 92% of the population. Unaccounted-for water is reaching almost 40%. The city has started a leak detection and control program financed under Loan 2072-KO, which would be complemented by the rehabilitation and replacement of old pipelines financed by the project.

13. Taegu Water Bureau (TWB), has independent budgets and accounts. The organization of TWB (Chart 3), includes 800 staff who have considerable experience in management, planning, operations and maintenance. Consultants and contractors are hired as necessary to assist city staff in major planning and improvement works.

14. Sanitation. The existing system consists of combined storm and waste water collector and main drains discharging into water courses and ultimately into the two main rivers - the Nakdong and the Guem Ho - draining the city. Premises are provided with either a septic tank or a cess pit which drains into the nearest street drain. The septic tanks and cess pits are desludged periodically. Night soil is treated in special treatment plants before disposal. In December 1984, the City completed, with the assistance of consultants, a Sewerage Master Plan which sets out priority plans and investments for sewage collection and treatment between 1985 and 2001. The city has started, with OECF assistance, the construction of the first treatment plant to serve the most densely built-up area. This 360,000 tpd facility will be completed in 1987. The city is also planning to construct interceptor sewers in the Dalseocheon catchment as well as in the adjoining Sincheon catchment, which are both considered a priority. Sewer tariffs amounting to 48% of the water tariffs would be levied from July 1985 and are expected to generate about Won 12 to 15 billion annually for sewerage investments. The above developments give room for confidence that Taegu City would embark on an adequate investment program for improvements in sewerage services before the project is commissioned in 1988. Garbage is collected directly by the Cleaning Section, as well as by private contractors working for the city, and disposed of by landfill or incineration. These services are well operated and maintained and the level of neighborhood sanitation is satisfactory.

15. Table 1 summarizes the details of the existing population served and water services in the project municipalities.

Environmental Aspects

16. The availability of reliable, adequate and safe water supply in the municipalities served would allow residents to improve health and sanitation and contribute to improve the environment. The only adverse environmental impact of the project, the increase in waste waters due to the expansion of water supply, is being addressed by the Master Plan mentioned above. Generally, municipalities in Korea maintain efficient public sanitation services like garbage collection and disposal, street cleaning, septic tank and night soil collection and disposal and maintenance of drains and water courses. Residents are also very conscious of the environment and maintain neighborhoods and premises clean. These factors result in better environmental conditions in urban areas than in most other developing countries.

17. The additional, assured year-round, water supply that would be provided by the project would alleviate some of these problems. Government is also now giving priority to the planning and financing of a country-wide program to provide improved collector and interceptor sewers and treatment facilities for urban areas. The cities themselves will start collecting, starting in 1986, sewerage tariffs amounting to up 30% to 50% of their water tariffs to finance improvements to waste water collection and disposal systems. These improvement programs, now in the planning stage, would, when implemented, help resolve sanitation problems. The smaller municipalities served by this subproject have lower densities and are situated in undeveloped agricultural areas, where lack of sewerage is not critical. Sanitation and health conditions would be improved with the availability of adequate and reliable piped water supply.

18. Both MOHA and MOC are preparing investment plans for country-wide improvement of waste water collection and disposal facilities in urban areas as part of Government's priority plans to deal with environmental pollution problems. The availability of adequate quantities of piped water at affordable prices would also improve household sanitary conditions, especially in the poorer neighborhoods. The Bank is presently discussing with both the Government and Taegu City investment priorities in sewerage which may be included in future projects.

KOREA - NAMGANG AND TAEGU WATER SUPPLY PROJECT

ANNEX 1
TABLE 1

EXISTING WATER SERVICES (1983) IN PROJECT MUNICIPALITIES

Cities (Si), Towns(Eups) and Villages (myons) 1]	Popu- lation (1000)	Annual Pop. Growth 1981-83	Area sq km	Urban Persons per Ha	Popu- Connec- ted (1000)	Number Connec- tions (1000)	% With Connec- tions	Persons per Connec- tion	Volume Produced, tpd	Volume Sold tpd	% Unac- for Water	Vol per conn. Tons Per Month	Sold Volume Per Person lpcd	Cost of Water Won per Ton	Water Tariff Won per Ton	Cost as % of Reve- ues
NAMGANG REGIONAL SYSTEM:																
Chungmu City	83.0	2.6%	20.6	40.0	69.0	7.5	83.1%	9.2	9843	6070	37.1%	24.3	88	190	207	92%
Chungmu Tourism Zone																
Goseong Eup	27.2	0.9%	31.9	8.5	14.7	2.0	84.0%	7.4	1610	1013	37.1%	15.2	68	100	110	91%
Gwando Myeon	9.0	-0.6%	38.5	2.3												
Georyu Myeon	8.8	-1.1%	36.5	2.4												
Dosan Myeon	7.4	-2.0%	38.2	1.9												
Jeongdong Myeon	5.8	-1.7%	36.5	1.6												
Daega Myeon	4.3	-2.2%	51.8	0.8												
Sangri Myeon	3.7	-6.1%	45.3	0.8												
CHUNGMU SYSTEM	149.2	1.2%	299.5	5.0	83.7	9.5	56.1%	8.8	11253	7083	37.1%	22.4	85	177	193	92%
Samcheonpo City	64.7	-0.7%	58.8	11.0	42.1	5.1	65.1%	8.3	4343	2734	37.0%	16.1	65	200	222	90%
Samcheonpo Tourism Zone																
Sacheon Eup	16.4	-1.5%	29.5	5.6	11.9	2.0	72.0%	5.9	2251	1417	37.1%	21.3	120	140	140	100%
Yonghyeon Myeon	8.3	-2.8%	27.4	3.0												
Sanam Myeon	7.2	-2.0%	41.3	1.7												
Chuckdong Myeon	5.1	-2.8%	22.9	2.2												
SAMCHEONPO SYSTEM	101.7	-1.7%	179.9	5.7	53.9	7.1	53.0%	7.6	6594	4151	37.0%	17.5	77	132	134	98%
TOTAL 13 MUNICIPALITIES NRS	250.9	0.2%	479.3	5.2	137.6	16.6	54.8%	8.3	17847	11234	37.1%	20.3	82	160	183	93%
TAEGU WATER SYSTEM																
TAEGU CITY 1983	1959.0	5.6%	455.0	43.1	1802.0	186.0	92.0%	9.1	402600	262900	34.7%	39.8	146	92	166	55%
TAEGU CITY 1984	2033.0	5.6%	455.0	44.7	1910.0	210.0	93.9%	9.1	490100	303900	38.0%	43.4	159	86	194	44%

1] Source: Municipal Yearbook of Korea - Ministry of Home Affairs, 1983/84

28-May-85

KOREA

NANGANG AND TAEGU WATER SUPPLY PROJECT

Project Description

A. Nam River Regional Water Supply System

1. General. The project is located in the Southeastern Coastal area of Kyeongnam Province and is the first regional water supply system for the area municipalities (Map IBRD 18965R). It serves the two main cities in the area, Samcheonpo and Chungmu with 1983 populations of 64,000 and 83,000 respectively. The project is also designed to serve two other small towns (eups) and 9 villages (myeons) which are near the proposed water transmission pipelines.

2. The project consists of; a raw water intake and pumping station drawing water from the existing Namgang Reservoir and sited on the opposite bank from Chinju City; a raw water transmission pipeline to a new treatment plant at Sacheon; a treatment plant and main treated water pumping station at Sacheon; treated water transmission pipelines including branch lines to the municipalities served; and a tunnel and a storage reservoir. Instrumentation for system monitoring and control and technical assistance for project design and supervision are also included.

3. The main physical works are:

(a) Raw Water Intake and Pumping Station. An intake tower in the Namgang Reservoir consisting of two 1,500mm diameter, 30m long pipes, feeding an intake well at the lower level and two 1.5m x 1.5m intake ports in the tower at the higher level, each intake being equipped with stainless steel bar screens and control sluice gates. The wet well has three separate compartments, with provision for installation of two vertical pumps in each. Three two-stage vertical intake pumps designed to deliver 0.44 cu m/sec at 45m total head would be installed in the first stage. The pump floor, vertically above the wet well, would accommodate the 300 kW, 3.3 kV motors, with vertical drives, and be equipped with overhead crane, pumping manifold and 1,100 mm diameter discharge pipe. A control room and office, 100 kVA electrical substation and flow meter chamber will also be provided .

(b) Raw Water Transmission. A single 1,100 mm diameter pipeline, about 17 km long, would transmit water from the intake at an elevation of 27.5 m to the water treatment plant at Sacheon at an elevation of 45.1 m with a high point at an elevation of 55.0 m.

(c) Water Treatment Plant. A treatment plant designed to handle 75,000 tpd raw water, to be expanded to 135,000 tpd in a second stage by 1992. The plant would be equipped for dosing and mixing of chemicals as required, flocculation, sedimentation, pH correction, filtration, and chlorination. In addition, the treatment process would include facilities for sludge thickening and lagooning and recovery of wash waters. A 10m x 4.5m x 3.7m

receiving chamber with provision for bypass, would be followed by a chemical dosing channel and mixing chamber 3.8m x 3.8m x 3.7m equipped with an electrically driven flash mixer. Each flocculation chamber, 420 cu m volume, would have two compartments arranged in series equipped with paddle mixers. Four horizontal flow, conventional-type clarifiers would be provided each 47m x 12m x 4.8 m average depth. Where appropriate, provision has been made to duplicate these facilities for a second stage. Six rapid sand single media filters would be provided, with provision for extension by another four later. Two treated water reservoirs, each 45m x 15m x 4.5m (6,000 cu m) would be provided. The treatment plant would have the necessary ancillary facilities for chemical storage, sludge lagooning and disposal, etc., and also the necessary control and instrumentation and laboratory facilities.

(d) Treated Water Pumping Station. The pumping station would be equipped to draw water from the clear wells into its suction well, and two banks of high service pumps would be designed to operate on the Chungmu and Samcheonpo lines separately. On the Chungmu line there would be three double suction 550 hp, 3.3 kV pumps designed to discharge 0.211 cu m/sec to operate against a total head of about 130 m, and has a provision for a later installation of another two similar pumps. On the Samcheonpo line there would be two 75kW and two 130kW, 3.3kV pumps designed to operate against a total head of 30m with provision for a later installation of two additional 130kW pumps. The station would be protected against water hammer by accumulators and relief valves and would be fully equipped with control and monitoring instrumentation and maintenance facilities.

(e) Treated Water Transmission Pipelines. The pipeline to Chungmu would be a 900mm diameter, 24.5 km long pumping line to the upper reservoir at Sangri and a 800mm diameter, 21.9 km long gravity line to Chungmu. A 540 m length of this gravity line just downstream of the reservoir would be laid in a 2.0 m wide horseshoe-shaped tunnel. The pipeline would be provided with the necessary branch lines and fittings to supply water to the seven other municipalities en route. The upper reservoir would provide 6,000 tons storage. The pipeline to Samcheonpo would be a 700 mm diameter, 14 km long pumping line with a 300 mm diameter, 7.3 km long branch line to Chuckdong. Steel pipelines will be fully protected against corrosion.

(f) Telemetry/Control System. The system would be provided with reading, processing and storage equipment for centralized monitoring and control, using leased telephone lines for communication. The treatment plant and the setting of the branch distribution valves would, however, be independently controlled.

B. Taegu City Water Supply System

4. General. The Taegu City Water Supply System (TWS) subproject is a continuation of the first stage extensions financed under the First Water Supply Project. Taegu is the third largest city

in Korea, the largest in Kyeongbug Province and is situated on the Nakdong River (Map IBRD 18969R). It is designed to serve Taegu City water requirements up to the year 1995.

5. The new works would provide an additional 407,000 tpd pumping capacity (including the provision for backwashing filters) at the existing intake works on the Nakdong River, constructed under Loan 2072-KO. The Dasa Treatment Works, also constructed under this loan, would be extended as planned to produce an additional 400,000 tpd of treated water. A duplicate main treated water transmission pipeline would connect to the existing city distribution network, improve supply conditions to most areas of the city and provide sufficient water to extend coverage to presently unserved areas. The project would also provide for necessary improvements to the main distribution network, additional storage reservoirs and booster pumping stations, and for replacement of older mains to complement the leakage control program.

6. The main works are:

(a) Intake and Pumping Station. Purchase and installation of ten sets of 250 hp 3.3 kV pumpsets with all associated equipment in the existing intake pumpstation;

(b) Dasa Treatment Plant and Pumping Station. Double its present production capacity to 800,000 tpd including chemical building, flocculation and sedimentation tanks, rapid sand filters, treated water reservoir, sludge disposal facilities, etc. Extension of the existing booster pump station by addition of three 900 kW and seven 450 kW pumps and associated equipment.

(c) Treated Water Transmission. A 1,800 mm diameter pipeline 5.6 km long (4.0 km being financed by the city).

(d) Distribution Improvements. Additional network links, 400-900 mm diameter and about 11 km long in aggregate, located at selected points in the network to improve service pressures and delivery capacity.

(e) Service Reservoirs and Booster Pump Stations. 80,000 tons of reservoir capacity at several locations, and three small booster pumpstations.

(f) Network Rehabilitation. Replacement of old pipe in the distribution network between 150 mm and 1200 mm diameter, 40 km long in aggregate, and the purchase of specialized leakage detection equipment, to complement the leakage detection and control program of the city.

7. The project also provides for (a) the extension and application to the NRS of the study for bulk water tariffs for ISWACO. Terms of Reference for this study had been agreed with ISWACO and are available in the Project File; and (b) a review of the organization of water and sewerage services in Taegu City (Terms of Reference, Annex 13)

KOREA - NAMGANG AND TAEGU WATER SUPPLY PROJECT

ANNEX 3A

POPULATION IN THE MUNICIPALITIES SERVED BY THE NAMGANG REGIONAL WATER SUPPLY SYSTEM 1] TABLE 1

Cities, Towns (Eubs), and Villages (Myuns)	POPULATION (1000 PERSONS)							ANNUAL POPULATION GROWTH RATES					
	1970	1981	1983	1988	1991	1996	2001	1970-81	1981-83	1983-88	1988-91	1991-96	1996-2001
Chungmu	54.00	78.60	83.00	98.58	108.98	128.81	151.51	3.5%	2.8%	3.5%	3.4%	3.4%	3.3%
Chungmu Tourism Zone													
Goseong Eup	25.10	28.70	27.20	32.31	35.82	41.53	48.20	0.6%	0.9%	3.5%	3.5%	3.0%	3.0%
Gwangdo Myun	10.40	9.10	9.00	8.80	8.60	8.17	7.76	-1.2%	-0.6%	-0.4%	-0.6%	-1.0%	-1.0%
Georyu Myun	11.00	9.01	8.80	8.34	8.10	7.70	7.30	-1.8%	-1.1%	-1.1%	-1.0%	-1.0%	-1.1%
Dosan Myun	9.40	7.70	7.40	7.40	7.30	7.10	7.00	-1.8%	-2.0%	0.0%	-0.5%	-0.6%	-0.3%
Jeongdong Myun	7.60	6.00	5.80	5.70	5.60	5.40	5.20	-2.1%	-1.7%	-0.3%	-0.6%	-0.7%	-0.8%
Daega Myun	7.10	4.50	4.30	4.22	4.10	3.90	3.70	-4.1%	-2.2%	-0.4%	-1.0%	-1.0%	-1.0%
Sangri Myun	6.00	4.20	3.70	3.70	3.70	3.70	3.70	-3.2%	-6.1%	0.0%	0.0%	0.0%	0.0%
CHUNGMU SYSTEM	130.60	145.80	149.20	169.05	182.20	206.31	234.37	1.0%	1.2%	2.5%	2.5%	2.5%	2.6%
Samcheonpo City	53.90	65.60	64.70	80.23	91.29	110.01	131.29	1.8%	-0.7%	4.4%	4.4%	3.8%	3.6%
Samcheonpo Tourism													
Sacheon Eup	17.00	18.90	18.40	19.85	22.45	26.67	29.90	-0.1%	-1.5%	4.0%	4.0%	3.5%	2.3%
Yonghyeon Myun	9.80	8.80	8.30	8.08	7.93	7.70	7.48	-1.1%	-2.9%	-0.6%	-0.6%	-0.6%	-0.6%
Sanam Myun	8.00	7.50	7.20	7.20	7.20	7.04	7.00	-0.6%	-2.0%	0.0%	0.0%	-0.4%	-0.1%
Chuckdong Myun	6.70	5.40	5.10	5.10	5.10	4.90	4.80	-1.9%	-2.6%	0.0%	0.0%	-0.8%	-0.4%
SAMCHEONPO SYSTEM	95.50	104.20	101.70	120.55	133.97	156.32	180.47	0.8%	-1.2%	3.5%	3.6%	3.1%	2.9%
13 MUNICIPALITIES	226.10	250.00	250.90	289.59	316.16	362.62	414.84	0.8%	0.2%	2.8%	3.0%	2.8%	2.7%

1] Source: Feasibility Study Namgang Water Supply Project (Renardet-MacDo-Jung Woo) as reviewed during appraisal.

10-May-85

PER CAPITA WATER CONSUMPTION AND POPULATION SERVED BY NAMGANG REGIONAL WATER SUPPLY SYSTEM TABLE 2

Cities, Towns (Eubs), and Villages (Myuns)	% POPULATION CONNECTED					POPULATION CONNECTED (1000)					PER CAPITA CONSUMPTION (lpcd)				
	1983	1988	1991	1996	2001	1983	1988	1991	1996	2001	1983	1988	1991	1996	2001
Chungmu	83.1%	84.0%	88.0%	91.0%	93.0%	69.0	82.8	95.8	117.2	140.9	88	177	190	200	200
Chungmu Tourism Zone															
Gosseong Eup	64.0%	74.0%	80.0%	84.0%	88.0%	14.7	23.9	28.7	34.9	42.4	69	155	165	170	175
Gwangdo Myun		52.0%	70.0%	74.0%	78.0%	0.0	4.6	6.0	6.0	5.9		88	105	130	130
Georyu Myun		52.0%	70.0%	74.0%	78.0%	0.0	4.3	5.7	5.7	5.5		88	105	130	130
Dosan Myun		52.0%	70.0%	74.0%	78.0%	0.0	3.8	5.1	5.3	5.3		88	105	130	130
Jeongdong Myun		52.0%	70.0%	74.0%	78.0%	0.0	3.0	3.9	4.0	4.0		88	105	130	130
Daega Myun		52.0%	70.0%	74.0%	78.0%	0.0	2.2	2.8	2.8	2.8		88	105	130	130
Sangri Myun		52.0%	70.0%	74.0%	78.0%	0.0	1.9	2.8	2.7	2.8		88	105	130	130
CHUNGMU SYSTEM	58.1%	74.9%	82.7%	86.6%	89.5%	83.7	126.8	150.7	178.7	209.7	85	159	170	184	188
Samcheonpo City	65.0%	78.0%	85.0%	90.0%	93.0%	42.1	63.4	77.8	99.0	122.1	85	177	190	200	200
Samcheonpo Tourism															
Sacheon Eup	72.0%	77.0%	80.0%	82.0%	85.0%	11.9	15.4	18.0	21.9	25.4	120	155	165	170	175
Yonghyeon Myun		52.0%	70.0%	74.0%	78.0%	0.0	4.2	5.5	5.7	5.7		88	105	130	130
Sanam Myun		52.0%	70.0%	74.0%	78.0%	0.0	3.7	5.0	5.2	5.3		88	105	130	130
Chuckdong Myun		52.0%	70.0%	74.0%	78.0%	0.0	2.7	3.6	3.6	3.6		88	105	130	130
SAMCHEONPO SYSTEM	53.0%	74.1%	81.9%	86.6%	89.9%	53.9	89.3	109.7	135.4	162.2	77	163	175	188	190
13 MUNICIPALITIES	54.6%	74.5%	82.4%	86.6%	89.6%	137.5	215.9	260.5	314.1	371.8	82	161	172	185	188

1] The per capita consumption excludes the tourism demand in Chungmu and Samcheonpo.

10-May

WATER PRODUCED AND SOLD ON THE MUNICIPALITIES IN THE NAMGANG REGIONAL WATER SUPPLY SYSTEM TABLE 3

Cities, Towns (Eubs), and Villages (Myuns)	WATER SOLD (TPD) 1]					% UNACCOUNTED-FOR WATER					AVG WATER PRODUCTION (TPD)				
	1983	1986	1991	1996	2001	1983	1986	1991	1996	2001	1983	1986	1991	1996	2001
Chungmu	6070	14657	18221	23443	28181	37%	33%	30%	28%	28%	9643	21875	26030	32560	39140
Chungmu Tourism Zone		2224	2870	4176	5904	37%	33%	30%	28%	28%	0	3320	4100	5800	8200
Goseong Eup	1013	3716	4728	5930	7423	37%	33%	30%	28%	28%	1610	5547	6755	8237	10309
Gwangdo Myun	0	403	632	786	787		28%	28%	28%	28%	0	559	878	1092	1065
Georyu Myun	0	382	595	741	721		28%	28%	28%	28%	0	530	827	1029	1002
Dosan Myun	0	339	537	683	692		28%	28%	28%	28%	0	470	745	949	961
Jeongdong Myun	0	261	412	518	514		28%	28%	28%	28%	0	362	572	722	714
Daega Myun	0	193	301	375	366		28%	28%	28%	28%	0	268	419	521	508
Sangri Myun	0	169	272	356	366		28%	28%	28%	28%	0	235	378	494	508
CHUNGMU SYSTEM	7083	22344	28568	37010	44933	37%	33%	30%	28%	28%	11254	33168	40703	51403	62406
Samcheonpo City	2734	11218	14744	19801	24419	37%	33%	30%	28%	28%	4343	16744	21082	27502	33915
Samcheonpo Tourism		348	490	864	1512		33%	30%	28%	28%	0	520	700	1200	2100
Sacheon Eup	1417	2381	2963	3718	4448	37%	33%	30%	28%	28%	2251	3554	4233	5163	6177
Yonghyeon Myun	0	369	583	741	739		28%	28%	28%	28%	0	513	809	1029	1027
Sanam Myun	0	329	529	677	692		28%	28%	28%	28%	0	458	735	941	961
Chuckdong Myun	0	233	375	471	474		28%	28%	28%	28%	0	324	521	655	659
SAMCHEONPO SYSTEM	4151	14880	19883	26272	32284	37%	33%	30%	28%	28%	6594	22112	28060	36489	44839
13 MUNICIPALITIES	11234	37224	48252	63282	77218	37%	33%	30%	28%	28%	17848	55280	68763	87892	107245

1] TPD = Metric Tons per Day (1,000 Kg or one cubic meter of water).

10-May

KOREA - NAMGANG AND TAEGU WATER SUPPLY PROJECT

ANNEX 3 A

PEAK DEMAND, ALLOCATION OF WATER AND WATER DEFICITS OR SURPLUS IN THE NAMGANG REGIONAL WATER SUPPLY SYSTEM

TABLE 4

(METRIC TONS PER DAY)

Cities, Towns (Eubs), and Villages (Myuns)	PEAK WATER DEMAND (TPD) 1]					OWN PRODUCTION CAPACITY (TPD)					PROJECT SUPPLIED CAPACITY (TPD)				WATER DEFICIT (-) OR SURPLUS				
	1983	1988	1991	1996	2001	1983	1988	1991	1996	2001	1988	1991	1996	2001	1983	1988	1991	1996	2001
Chungmu 2]	12054	27344	32538	40700	48926	12500	500	500	500	500	31200	31200	48200	48200	446	4356	-838	8000	-226
Chungmu Tourism Zone	0	4150	5125	7250	10250						4100	4100	10000	10000	0	-50	-1025	2750	-250
Goseong Eup	2013	6934	8443	10296	12887	3300	3300	3300	3300	3300	5200	5200	9000	9000	1287	1566	57	2004	-587
Gwangdo Myun	0	699	1097	1365	1331	500	500	500	500	500	800	800	900	900	500	401	3	35	69
Georyu Myun	0	863	1034	1286	1252						1100	1100	1300	1300	0	437	66	14	48
Dosan Myun	0	588	932	1106	1201						1000	1000	1200	1200	0	412	68	14	-1
Jeongdong Myun	0	453	715	902	892						700	700	900	900	0	247	-15	-2	8
Daega Myun	0	335	523	651	635						500	500	600	600	0	165	-23	-51	-35
Sangri Myun	0	294	472	618	635						500	500	600	600	0	206	28	-18	-35
CHUNGMU SYSTEM	14067	41460	50879	64253	78008	16300	4300	4300	4300	4300	44900	44900	72700	72700	2233	7740	-1678	12747	-1008
Samcheonpo City 3]	5429	20930	26328	34377	42394	14000	14000	14000	14000	14000	12300	12300	29600	29600	8571	5370	-28	9223	1206
Samcheonpo Tourism	0	650	875	1500	2025						700	700	2700	2700	0	50	-175	1200	75
Sacheon Eup	2814	4443	5291	6454	7722	1800	1800	1800	1800	1800	4500	4500	6600	6600	-1014	1857	1009	1946	678
Yonghyeon Myun	0	641	1011	1286	1283						1100	1100	1300	1300	0	459	89	14	17
Sanam Myun	0	572	818	1176	1201						800	800	1200	1200	0	328	-18	24	-1
Chuckdong Myun	0	406	651	818	823						700	700	800	800	0	295	49	82	77
SAMCHEONPO SYSTEM	8243	27641	35075	45611	56048	15800	15800	15800	15800	15800	20200	20200	42300	42300	7557	8359	825	12489	2052
1J MUNICIPALITIES	22310	69100	85954	109865	134056	32100	20100	20100	20100	20100	65100	65100	115000	115000	9790	16100	-754	25235	1044

1] The maximum daily demand is 1.25 times the average water production.

2] After the project completion Chungmu would have to abandom the water taken from underground sources which belong to other municipalities

3] Samcheonpo own capacity is only 3,000 tpd, but is using temporarily water which belong to the Samcheonpo industrial estate. The capacity of the industrial estate pipeline would be expanded from 20,000 tpd to 30,000 tpd by 1989. The water demand in this industrial estate, including KEPCO thermoelectric power plant, is expected to increase from 6,000 tpd in 1988, to 12,000 tpd in 1996 and 21,598 tpd in 2001. The water available to Samcheonpo is 14,000 tpd.

31-May

KOREA – NAMGANG AND TAEGU WATER SUPPLY PROJECT ANNEX 3 A

POPULATION BENEFITED, WATER DEMAND & SUPPLY ON THE NAMGANG REGIONAL SYSTEM. TABLE 5

A] C H U N G M U S Y S T E M

YEAR	TOTAL POPU-LATION	POPU-LATION SERVED	BULK WATER DEMAND	RETAIL WATER SOLD	SUPPLY FROM OTHER SOURCES	WATER SUPPLIED BY THE PROJECT — BULK —		— RETAIL —		INCRE-MENTAL POPUL. BENE-FITED	POPUL. ALSO SUPPLIED BY PROJECT 2]	TOTAL POPU-LATION SERVED 3]
	1000	1000	TPD	TPD	TPD 1]	TPD	MILLION TON/YEAR	TPD	MILLION TON/YEAR			1000
1983	148.2	83.7	11254	7083								
1984	153.0	84.1	11310	7118								
1985	156.8	84.5	11368	7154								
1986	160.8	84.9	11423	7190								
1987	164.9	85.3	11480	7228								
1988	169.0	126.8	33188	22344	3870	29298	10.69	19737	7.20	42.1	73.4	115.5
1989	173.3	134.1	35486	24231	3870	31816	11.54	21588	7.88	49.8	72.8	122.4
1990	177.8	142.0	37966	26278	3870	34086	12.45	23600	8.61	57.5	72.1	129.8
1991	182.2	150.7	40703	28568	3870	36833	13.44	25862	9.44	66.2	71.3	137.8
1992	186.8	156.0	42648	30087	3870	38778	14.15	27356	9.89	71.5	71.8	143.3
1993	191.5	161.4	44686	31885	3870	40816	14.90	28941	10.56	76.9	72.4	149.3
1994	196.3	167.0	46821	33369	3870	42855	15.57	30400	11.10	82.5	73.0	155.5
1995	201.2	172.7	49058	35142	3870	42855	15.57	30555	11.15	88.2	73.7	162.0
1996	206.3	178.7	51403	37010	3870	47533	17.35	34224	12.49	94.2	74.5	168.7
1997	211.6	184.5	53436	38474	3870	49588	18.09	35688	13.03	100.0	74.2	174.2
1998	217.1	190.5	55550	39998	3870	51680	18.86	37209	13.58	106.0	73.9	179.8
1999	222.7	196.7	57747	41578	3870	53877	19.67	38792	14.16	112.2	73.5	185.7
2000	228.5	203.1	60032	43223	3870	56162	20.50	40436	14.76	118.6	73.2	191.7
2001	234.4	209.7	62406	44933	3870	58536	21.37	42146	15.38	125.2	72.8	198.0

B] S A M C H E O N P O S Y S T E M

1983	101.7	53.9	6594	4151								
1984	105.2	54.1	6627	4171								
1985	108.9	54.4	6680	4192								
1986	112.8	54.7	6684	4213								
1987	116.5	80.5	7408	4662								
1988	120.5	88.3	22112	14880	14220	7892	2.88	5311	1.94	34.9		34.8
1989	124.9	95.7	23938	16333	14220	9718	3.55	6831	2.42	41.3		41.3
1990	129.3	102.4	25814	17828	14220	11894	4.27	8090	2.95	48.0	9.4	57.5
1991	134.0	109.7	28080	19683	14220	13840	5.05	9708	3.54	55.3	6.3	61.6
1992	138.2	114.4	29574	20853	14220	15354	5.60	10828	3.95	60.0	7.8	67.8
1993	142.5	118.3	31189	22093	14220	16949	6.19	12014	4.38	64.8	9.4	74.3
1994	147.0	124.5	32850	23407	14220	18630	6.80	13274	4.85	70.1	11.8	81.7
1995	151.8	129.8	34822	24798	14220	20402	7.45	14613	5.23	75.4	14.3	89.7
1996	156.3	135.4	36488	26272	14220	22269	8.13	16034	5.85	81.0	17.8	98.8
1997	160.9	140.4	38024	27377	14220	23804	8.69	17139	6.26	86.0	16.2	102.2
1998	165.8	145.5	39824	28529	14220	25404	9.27	18291	6.68	91.1	14.8	106.0
1999	170.4	150.9	41291	29730	14220	27071	9.88	19491	7.11	96.5	13.4	109.8
2000	175.4	156.4	43028	30980	14220	28808	10.52	20742	7.57	102.0	11.8	113.9
2001	180.5	162.2	44839	32284	14220	30618	11.18	22045	8.05	107.8	10.3	118.1

1] Given daily and seasonal demand variations the annual average use can not exceed 90% of nominal capacity.

2] Given existing constraints in existing supply and distribution networks, the incremental population served is the difference with 1985.

3] The population served is prorated between the project and present sources in proportion to their capacities.

10-May

KOREA - NAMGANG AND TAEGU WATER SUPPLY PROJECT — ANNEX 3 A

POPULATION AND DEMAND SUMMARY FOR THE NAMGANG REGIONAL WATER SYSTEM 1] — TABLE 6

YEAR	TOTAL POPULATION 1000	POPULATION SERVED 1000	BULK WATER DEMAND TPD	RETAIL WATER SOLD TPD	CONSUMPTION PER CAPITA LPCD	SUPPLY FROM OTHER SOURCES TPD	WATER SUPPLIED BY THE PROJECT — BULK — TPD	BULK — MILLION TON/YEAR	— RETAIL — TPD	RETAIL — MILLION TON/YEAR	INCREMENTAL POPUL. BENEFITED	POPUL. ALSO SUPPLIED BY PROJECT	TOTAL POPULATION SERVED 1000
1983	251	138	17848	11234	81.7								
1984	258	138	17937	11280	81.7								
1985	266	139	18027	11346	81.7								
1986	273	140	18117	11403	81.7								
1987	281	146	18887	11888	81.5								
1988	290	216	55280	37224	172.4	18090	37190	13.57	25048	9.14	77.0	73.4	150.4
1989	298	230	59424	40564	176.6	18090	41334	15.08	28219	10.30	90.8	72.8	163.6
1990	307	244	63880	44206	180.8	18090	45790	16.71	31690	11.57	105.8	81.5	187.1
1991	316	260	68763	48252	185.3	18090	50673	18.50	35561	12.98	121.5	77.6	199.1
1992	325	270	72221	50940	188.4	18090	54131	19.76	38163	13.94	131.5	79.5	210.9
1993	334	281	75854	53779	191.6	18090	57764	21.08	40955	14.95	141.8	81.8	223.6
1994	343	291	79671	56776	194.8	18090	61285	22.37	43674	15.94	152.5	84.8	237.2
1995	353	303	83690	59940	198.1	18090	65057	23.02	45188	16.49	163.7	88.0	251.7
1996	363	314	87892	63282	201.5	18090	69802	25.48	50257	18.34	175.2	92.1	267.3
1997	373	325	91480	65851	202.7	18090	73370	26.78	52827	19.28	186.0	90.4	276.4
1998	383	336	95174	68525	203.9	18090	77084	28.14	55500	20.26	197.1	88.7	285.8
1999	393	348	99038	71308	205.2	18090	80948	29.55	58283	21.27	208.7	86.9	295.6
2000	404	359	103060	74203	206.4	18090	84970	31.01	61178	22.33	220.8	85.0	305.8
2001	415	372	107245	77218	207.7	18090	89155	32.54	64181	23.43	232.8	83.1	316.0

1] This table summarizes the demand for Chugmu and Samcheonpo presented in table 5.

10-May

TAEGU WATER SYSTEM

POPULATION AND WATER DEMAND PROJECTIONS

YEAR	POPULATION (End of Year)	WATER CONNECTIONS	PERCENT SUPPLIED WITH WATER	POPULATION SUPPLIED WITH WATER	PERSONS PER CONNECTION	WATER SOLD LPCD 1]	WATER SOLD 1000 TONS / YEAR	WATER SOLD TONS PER DAY	WATER SOLD TONS PE MONTH PER CONNECTION	WATER PRODUCTION 1000 TONS / YEAR	% UNACCOUNTED FOR WATER	WATER PRODUCTION 1000 TONS PER DAY	PRODUCTION CAPACITY 1000 TONS PER DAY	MAXIMUM DAILY DEMAND 1.25 FACTOR	WATER SOLD BY PROJECT 1000 TONS / YEAR 2]	INCREMENTAL POPUL. SERVED BY PROJECT 1000 2]
1984	1266.0	97.12	79.78%	1010	10.40	101	37348	102.3	32.0	65251	42.8%	178.8	180	223		
1985	1311.0	103.69	80.86%	1060	10.22	115	44873	122.4	35.9	72817	38.7%	199.5	230	249		
1986	1359.0	110.48	82.12%	1116	10.10	121	49140	134.6	37.1	79778	38.4%	218.6	260	273		
1987	1416.0	121.71	84.32%	1194	9.81	126	55073	150.9	37.7	93000	40.8%	254.8	325	318		
1988	1487.0	131.65	86.76%	1384	10.50	124	63243	173.3	40.1	100725	37.2%	276.0	325	345		
1989	1578.0	146.76	94.16%	1481	10.09	133	71943	196.8	40.8	117277	38.7%	321.3	325	402		
1990	1807.5	180.54	95.89%	1543	9.81	134	75711	207.4	39.8	124470	39.2%	341.0	425	426		
1991	1839.0	179.03	91.05%	1673	9.40	133	81205	222.5	38.0	129917	37.5%	355.9	425	445		
1992	1904.3	188.13	91.02%	1733	9.21	135	85221	233.5	37.7	128483	33.7%	352.0	425	440		
1993	1959.0	199.00	91.99%	1802	9.10	146	95974	262.9	40.4	147028	34.7%	402.8	425	504		
1994	2033.0	210.00	93.85%	1910	9.10	159	110906	303.9	44.0	178872	38.0%	490.1	625	613		
1995	2106.2	217.56	94.00%	1980	9.10	167	120708	330.7	46.2	184690	38.0%	533.4	625	667		
1996	2182.0	226.11	94.30%	2058	9.10	175	131432	360.1	48.4	205362	36.0%	562.6	625	703		
1997	2260.6	235.00	94.60%	2138	9.10	185	144402	395.6	51.2	218790	34.0%	599.4	660	749		
1998	2341.9	245.78	95.50%	2237	9.10	195	159187	436.1	54.0	237502	33.0%	650.9	660	814	7393	99.1
1999	2426.3	256.82	97.00%	2353	9.10	203	174380	477.8	56.2	256441	32.0%	702.6	1260	878	22598	215.0
2000	2513.6	269.31	97.50%	2451	9.10	211	189745	517.1	58.4	277566	32.0%	760.5	1260	951	36951	312.9
2001	2604.1	280.44	98.00%	2552	9.10	218	203063	556.3	60.3	294294	31.0%	806.3	1260	1008	51269	413.5
2002	2697.4	296.18	98.00%	2604	9.10	225	213975	586.0	62.3	309964	31.0%	849.2	1260	1062	62081	485.8
2003	2716.1	292.50	98.00%	2662	9.10	231	224718	615.7	64.0	321028	30.0%	878.5	1260	1099	72924	523.3
2004	2776.1	300.49	98.50%	2734	9.10	238	237315	650.2	65.8	339022	30.0%	928.8	1260	1161	85521	595.9
2005	2837.4	307.12	98.50%	2795	9.10	244	249347	683.1	67.7	356210	30.0%	975.9	1260	1220	97553	656.3
2006	2900.0	313.90	98.50%	2857	9.10	251	261988	717.8	69.6	374269	30.0%	1025.4	1260	1282	110194	718.0
2007	2948.4	320.76	99.00%	2919	9.10	262	278132	764.7	72.5	397760	30.0%	1082.5	1260	1366	115342	780.4
2008	2997.5	328.10	99.00%	2968	9.10	269	291733	799.3	74.5	416781	30.0%	1141.8	1260	1427	115342	780.4
2009	3047.5	331.54	99.00%	3017	9.10	277	304803	835.8	76.6	435575	30.0%	1193.4	1260	1492	115342	780.4
2000	3098.3	337.07	99.00%	3067	9.10	285	319667	873.1	78.8	456938	30.0%	1247.2	1260	1559	115342	780.4
2001	3150.0	342.69	99.00%	3119	9.10	293	333052	912.5	81.0	475789	30.0%	1303.5	1260	1629	115342	780.4

1] Real until 1984. Based on KECC's per capita consumption (Revised Demand Projections 4/13/1985), lagged by one year up to 1992. The per capita demand is increased by 2.5% p.a. each year thereafter.

2] Given the daily and yearly demand seasonality and maintenance needs the maximum water sold per year is 90% of the maximum daily capacity. Without leak detection works (whose cost is included in the economic analysis), unaccounted-for water is assumed to remain at 38% reducing the volume sold from present sources. Furthermore, without the network expansion, reservoirs and rehabilitation included in the project the water sold could not be increased after 1987. Therefore the population served by the project is assumed as the difference with 1987, and the water sold as the difference with the water sold by June 1988. The maximum water sold includes this initial capacity, and the use up to 90% of the 400,000 tpd production capacity, reduced by 30% unaccounted-for water.

06-May

PROJECT COST OF THE NAMGANG REGIONAL SYSTEM 1]

WORKS	MILLION WON			% OF BASE COST	MILLION US$			% Foreign	MILLION US$			
	Local	Foreign	Total		Local	Foreign	Total		1985	1986	1987	1988
1. INTAKE	639	377	1017	3.71%	0.75	0.44	1.20	37.1%	0.00	0.70	0.50	0.00
Civil Works	523	203	727	2.65%	0.62	0.24	0.86	28.0%	0.00	0.60	0.26	0.00
Equipment	116	174	290	1.06%	0.14	0.20	0.34	60.0%	0.00	0.10	0.24	0.00
2. RAW WATER TRANSMISSION	2291	2144	4435	16.19%	2.70	2.52	5.22	48.4%	0.00	2.35	2.35	0.52
Civil Works	1437	559	1996	7.28%	1.69	0.66	2.35	28.0%	0.00	1.06	1.06	0.23
Equipment	854	1586	2439	8.90%	1.00	1.87	2.87	65.0%	0.00	1.29	1.29	0.29
3. WATER TREATM.& PUMPING ST.	2393	1913	4307	15.72%	2.82	2.25	5.07	44.4%	0.00	P.03	2.22	0.82
Civil Works	1888	734	2623	9.57%	2.22	0.86	3.09	28.0%	0.00	1.23	1.23	0.62
Equipment	505	1179	1684	6.15%	0.59	1.39	1.98	70.0%	0.00	0.79	0.98	0.20
4. TREATED WATER TRANSMISSION	5319	4871	10190	37.19%	6.26	5.73	11.99	47.8%	0.00	4.80	4.80	2.40
Civil Works	3301	1284	4585	16.73%	3.88	1.51	5.39	28.0%	0.00	2.16	2.16	1.08
Equipment	2018	3587	5605	20.46%	2.37	4.22	6.59	64.0%	0.00	2.64	2.64	1.32
5. SERVICE RESERVOIRS	233	100	333	1.22%	0.27	0.12	0.39	30.0%	0.00	0.20	0.20	0.00
6. TUNNELS	400	215	615	2.24%	0.47	0.25	0.72	35.0%	0.00	0.36	0.36	0.00
7. INSTRUMENTATION & CONTROLS	300	1700	2000	7.30%	0.35	2.00	2.35	85.0%	0.00	0.71	1.18	0.47
8. LAND ADQUISITION	580	0	580	2.12%	0.68	0.00	0.68	0.0%	0.14	0.41	0.14	0.00
9. ENGINEERING AND TRAINING	800	200	1000	3.65%	0.94	0.24	1.18	20.0%	0.00	0.47	0.47	0.24
10. TAXES & DUTIES	2925	0	2925	10.67%	3.44	0.00	3.44	0.0%	0.00	1.38	1.55	0.52
BASIC COST, PRICES JUNE 1985	15880	11521	27401	100.00%	18.68	13.55	32.24	42.0%	0.14	13.39	13.75	4.96
PHYSICAL CONTINGENCIES	1588	1152	2740	10.00%	1.87	1.36	3.22	42.0%	0.01	1.34	1.38	0.50
PRICE CONTINGENCIES	1261	870	2131	7.78%	2.37	1.68	4.05	41.5%	.00	0.80	2.06	1.19
TOTAL PROJECT COST 1]	18730	13543	32273	117.78%	22.92	16.58	39.51	42.0%	0.15	15.53	17.19	6.64

1] Due to rounding the last digit in totals may appear different than the sum of digits

30-Apr-85

PROJECT COST OF THE TAEGU WATER SUPPLY SYSTEM 1]

WORKS	MILLION WON			% OF BASE COST	MILLION US$			% Foreign	MILLION US$			
	Local	Foreign	Total		Local	Foreign	Total		1985	1986	1987	1988
1. INTAKE	1040	960	2000	4.52%	1.22	1.13	2.35	48.0%	0.00	1.41	0.94	0.00
Civil Works	560	240	800	1.81%	0.66	0.28	0.94	30.0%	0.00	0.71	0.24	0.00
Equipment	480	720	1200	2.71%	0.56	0.85	1.41	60.0%	0.00	0.71	0.71	0.00
2. TREATMENT PLANT	10400	7600	18000	40.66%	12.24	8.94	21.18	42.2%	1.47	7.18	7.00	5.53
Civil Works	6750	3750	12500	28.24%	10.28	4.41	14.71	30.0%	1.47	5.88	4.41	2.94
Equipment	1650	3850	5500	12.43%	1.94	4.53	6.47	70.0%	0.00	1.29	2.59	2.59
3. TRANSMISSION PIPELINES	1473	1627	3100	7.00%	1.73	1.91	3.65	52.5%	0.36	2.31	0.98	0.00
Civil Works	735	315	1050	2.37%	0.86	0.37	1.24	30.0%	0.12	0.82	0.48	0.00
Equipment	738	1312	2050	4.63%	0.87	1.54	2.41	64.0%	0.24	1.69	0.48	0.00
4. DISTRIBUTION NETWORKS	1968	1432	3300	7.48%	2.20	1.68	3.88	43.4%	0.00	1.01	1.65	1.32
Civil Works	1400	600	2000	4.52%	1.65	0.71	2.35	30.0%	0.00	0.71	0.94	0.71
Equipment	466	832	1300	2.94%	0.55	0.98	1.53	64.0%	0.00	0.31	0.61	0.61
5. SERVICE RESERVOIRS	3360	1440	4800	10.84%	3.95	1.69	5.65	30.0%	0.00	1.69	1.69	2.28
6. PUMPING STATION	386	214	600	1.36%	0.45	0.25	0.71	35.7%	0.00	0.21	0.28	0.21
Civil Works	350	150	500	1.13%	0.41	0.18	0.59	30.0%	0.00	0.18	0.24	0.18
Equipment	36	64	100	0.23%	0.04	0.08	0.12	64.0%	0.00	0.04	0.05	0.04
7. NETWORK REHABILITATION	2626	2214	4840	10.93%	3.09	2.60	5.69	45.7%	0.00	1.71	2.28	1.71
Civil Works	1820	780	2600	5.87%	2.14	0.92	3.06	30.0%	0.00	0.92	1.22	0.92
Equipment	806	1434	2240	5.06%	0.95	1.69	2.64	64.0%	0.00	0.79	1.05	0.79
8. OTHER WORKS	85	1915	2000	4.52%	0.10	2.25	2.35	95.8%	0.00	0.35	1.00	1.00
Leak Detection	0	300	300	0.68%	0.00	0.35	0.35	100.0%	0.00	0.35	0.00	0.00
System Instrum. & Control	85	1615	1700	3.84%	0.10	1.90	2.00	95.0%	0.00	0.00	1.00	1.00
9. LAND	750	0	750	1.69%	0.88	0.00	0.88	0.0%	0.35	0.35	0.18	0.00
10. TAXES & DUTIES	3800	0	3800	8.58%	4.47	0.00	4.47	0.0%	0.45	1.79	1.34	0.89
11. ENGIN. & TECH. ASSISTANCE	699	376	1075	2.43%	0.82	0.44	1.26	35.0%	0.13	0.38	0.38	0.38
BASIC COST. PRICES JUNE 1985	26487	17778	44265	100.00%	31.16	20.92	52.08	40.2%	2.78	18.39	17.62	13.30
PHYSICAL CONTINGENCIES	2649	1778	4427	10.00%	3.12	2.09	5.21	40.2%	0.28	1.84	1.76	1.33
PRICE CONTINGENCIES	2122	1451	3573	8.07%	4.07	2.86	6.92	41.3%	0.01	1.05	2.58	3.27
TOTAL PROJECT COST 1]	31258	21007	52265	118.07%	38.34	25.88	64.21	40.3%	3.05	21.28	21.97	17.90

1] Due to rounding the last digit in totals may appear different than the sum of digits

KOREA
NAMGANG AND TAEGU WATER SUPPLY PROJECT
IMPLEMENTATION SCHEDULE

Key Implementation Actions /1 (1985 and 1986)

Component	Appraisal Estimate
NRS - PART A	
- Publication of Dev. Forum General Proc. Notice	Done (03/85)
- Appointment by ISWACO of Consultants for Tariff Study	07/85
- Completion of Detailed Engineering	08/85
- Completion of Land Acquisition	12/86
- Prequalification of Civil Works Contractors (4 lots)	08/85
- Civil Works (Bidding; Award)	
Lot #1 - Intake & Raw Water	08/85; 12/85
Lot #2 - Treatment Plant	01/86; 05/86
Lot #3 - Transmission	01/86; 05/86
Lot #4 - Transmission	01/86; 05/86
- Equipment (Bidding; Award)	
for Lot #1	09/85; 12/85
for Lot #2	06/86; 10/86
for Lot #3 & #4	06/86; 10/86
Instrumentation and Control	04/86; 08/86
- Appointment of Consultants for Supervision	02/86
- Establishment of Site Office	12/85
- Completion of Tariff Study	06/86

/1 See also Construction Schedule (page 3).

Component	Appraisal Estimate
TWS - PART B	
- Publication of General Proc. Notice in Dev. Forum	Done 12/84
- Completion of Detailed Engineering	06/85
- Completion of Land Acquisition	12/85
- Appointment of Supervising Consultants	08/85
- Completion of Prequalification of Civil Works Contractors (Lots 1-3)	06/85
- Civil Works (Bidding; Award)	
Lot #1 - Intake	10/86; 02/87
Lot #2 - Treatment Plant	08/85; 12/85
Lot #3 - Transmission	10/85; 02/86
Lot #4 - Distribution	02/86; 04/86
Lot #5 - Distribution	01/87; 03/87
Lot #6 - Distribution	01/88; 03/88
Lot #7 - Rehabilitation	02/86; 04/86
Lot #8 - Rehabilitation	01/87; 03/87
Lot #9 - Rehabilitation	01/88; 03/88
- Goods (Bidding; Award)	
for Lot #1	10/86; 02/87
for Lot #2	06/86; 10/86
for Lot #3	02/86; 06/86
for Lot #4	02/86; 04/86
for Lot #5	01/87; 03/87
for Lot #6	01/88; 03/88
for Lot #7	02/86; 04/86
for Lot #8	01/87; 03/87
for Lot #9	01/88; 03/88
Leak Detection Equipment	02/86; 05/86
Instrumentation and Control Equipment	04/86; 07/86
- Completion of Review by MOHA of Organization of Water and Sewerage Services for Bank comments	12/86

NAMGANG AND TAESU WATER SUPPLY PROJECT

CONSTRUCTION SCHEDULE

WORKS		DESCRIPTION	LOT #	COST MILLION 1985 WON	1985 1 2 3 4 5 6 7 8 9 10 11 12	1986 1 2 3 4 5 6 7 8 9 10 11 12	1987 1 2 3 4 5 6 7 8 9 10 11 12	1988 1 2 3 4 5 6 7 8 9 10 11 12
A) NAMGANG REGIONAL SYSTEM								
1. Intake	CW	Capacity 135,000 tpd	1	727	DDDDDDDDDDDDDDDDDDBBBAAA	==========60%	==========100%	
	EQ	3/800 KW Pumpsets	1	290	BBBBAAA	==========25%	==========100%	
2. Raw Water Transmission	CW	17 km, 1,200 mm	1	1998	DDDDDDDDDDDDD	BBBBAAA==========60%	==========100%	
	EQ		1	2438		BBBBAAA==========40%	==========100%	
3. Treatment Plant	CW	75,000 tpd, Reservoir 6,000t	2	2622	DDDDDDDDDDDDD	BBBBAAA==========40%	==========80%	====100%
	EQ	3/550 Kw, 2/75 Kw; 2/130 Kw	2	1884		BBBBAAA==========40%	==========80%	====100%
4. Treated Water Pipeline	CW	24.5 km, 900 mm; 35.8 km,	3,4	4586	DDDDDDDDDDDDD	BBBBAAA==========40%	==========80%	==========100%
	EQ	800 mm; 7.8 Km, 300 mm	3,4	5805		BBBBAAA==========40%	==========80%	==========100%
5. Service Reservoirs	CW	6,000 t	4	333	DDDDDDDDDDDDD	BBBBAAA==========50%	==========100%	
6. Tunnels	CW	540 m, 2,000 mm	4	615	DDDDDDDDDDDDD	BBBBAAA==========100%		
7. Instrumentation & Control		1 Lot		2000		BBBBAAA ======40%	==========80%	====100%
8. Land Acquisition		17 ha.		[illegible]	==========20%	==========70%	==========100%	
TOTAL NAMGANG SYSTEM		Excluding Eng.Conting.& Tax.		23477	==========0.4%	==========42%	==========86%	==========100%
B) TAESU WATER SYSTEM								
1. Intake	CW	Capacity 420,000 tpd	1	800	DDDDDDDDDDDD	BBBBAAA==35%	==========100%	
	EQ	10/250 Hp Pumpsets		1200		BBBBAAA==	==========100%	
2. Treatment Plant &	CW	400,000 tpd,	2	12500	DDDDDDDDDDDD	BBBBAAA=10%	==========80%	==========80%	==========100%
Pump station.	EQ	3/800 Kw, 7/450 Kw Pumpsets		7500		BBBBAA======20%	==========60%	==========60%	==========100%
3. Transmission Pipe.	CW	5.8 Km, 1,800 mm	3	1050	DDDDDDDDDDDD	BBBBAAA=10%	==========60%	==========100%	
	EQ			2050		BBBBAAA=10%	==========80%	==========100%	
DISTRIBUTION SYSTEMS	CW		4,5,6			BBBAA==========70%	BBAA==========60%	BBAA==========100%
DISTRIBUTION SYSTEMS	EQ					BBBAA==========30%	==========70%	========100%
4. Distribution Networks	CW	11 Km, 700 to 1,000 mm,		2000	DDDDDDDDDDDD			
	EQ			1300				
5. Service Reservoirs	CW	3/ 60,000 tons total.		4800				
6. Pumping Station	CW	3/ Booster		500				
	EQ			100				
7. Network Rehabilitation	CW	40 Km, 80 to 500 mm	7,8,9	2600		BBBAA==========30%	BBAA==========70%	BBAA==========100%
	EQ			2240		BBBAA==========30%	BBAA==========70%	BBAA==========100%
8. Other Works		Leak Detection Equipment	-	800	DDDDDDDDDDDD	BBBBAAA ==========100%		
		1 Lot Control & Instrument.	-	1700			NNNAA==========57%	==========100%
9. Land		6 ha.		750	==========40%	==========60%	==========100%	
TOTAL TAESU WATER SYSTEM		Excluding Eng.Conting.& Tax.		39390	==========5%	==========41%	==========75%	==========100%

D = DETAILED ENGINEERING
N = NEGOTIATIONS
B = BIDDING
A = AWARDING
CW = CIVIL WORKS
EQ = EQUIPMENT

18-Jul-86

Annex 6

KOREA

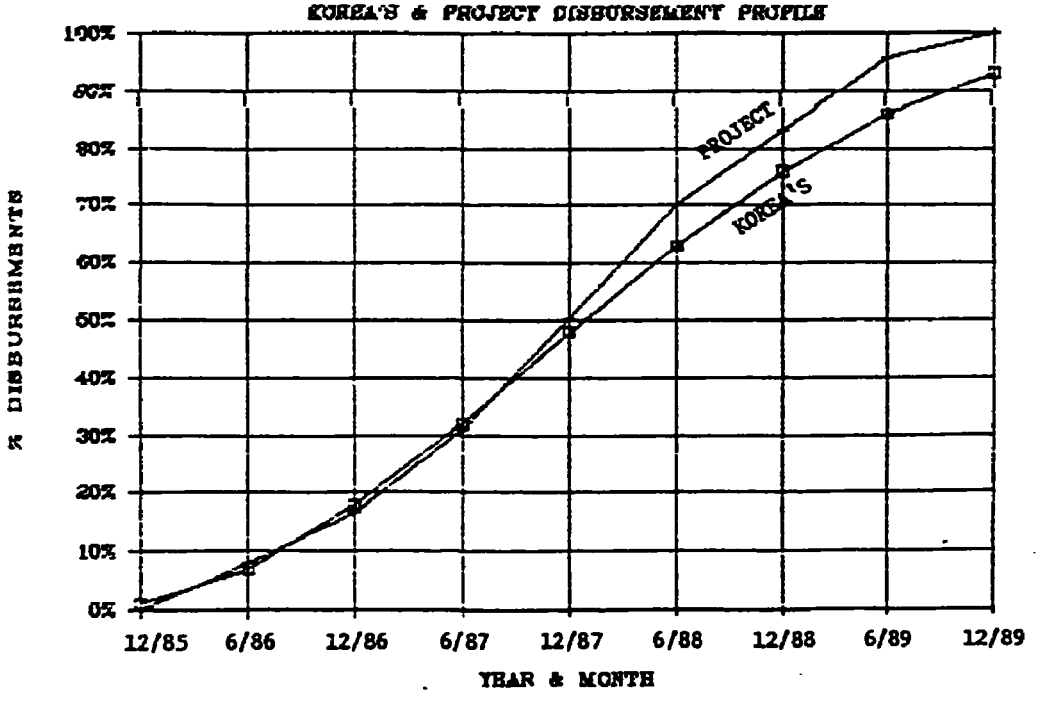
NAMGANG AND TAEGU WATER SUPPLY PROJECT

DISBURSEMENT SCHEDULE 1]

[US$ Million]

Bank's Fiscal Year	Year and Semester Ending	NAMGANG DISBURSEMENTS		TAEGU DISBURSEMENTS		TOTAL CUMULATIVE DISBURS-EMENTS	DISBURSEMENT PROFILE	
		Semester	Cumulative	Semester	Cumulative		Korea's	Project's
1986	31-Dec-85		0.0		0.0	0.0	1.0%	0.0%
	30-Jun-86	1.5	1.5	1.5	1.5	3.0	7.0%	7.9%
1987	31-Dec-86	1.00	2.5	2.3	3.8	6.3	18.0%	16.6%
	30-Jun-87	2.50	5.0	3.0	6.8	11.8	32.0%	31.1%
1988	31-Dec-87	3.30	8.3	4.0	10.8	19.1	48.0%	50.3%
	30-Jun-88	3.40	11.7	4.1	14.9	26.6	63.0%	70.0%
1989	31-Dec-88	1.40	13.1	3.6	18.5	31.6	76.0%	83.2%
	30-Jun-89	1.30	14.4	3.5	22.0	36.4	88.0%	95.8%
1990	31-Dec-88	0.60	15.0	1.0	23.0	38.0	93.0%	100.0%
	30-Jun-90		15.0		23.0	38.0	97.0%	100.0%

1] Includes the initial disbursement of $ 3 million for the Special Account.



ISWACO - WATER DIVISION.

ANNEX 7
TABLE 1

INCOME STATEMENT 1] Million Won

FY ends 12/31

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Raw Water Sold - Million mt	819	1010	1120	1148	1220	1235	1283	1465	1561	1671
Treated Water Sold - Million mt	28	35	56	71	83	117	187	366	449	538
Total Water Sold - Million mt	847	1045	1176	1220	1321	1352	1430	1831	2010	2209
% Unaccounted-for Water	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Water Production - Million mt	897	1100	1238	1284	1391	1423	1505	1928	2115	2325
Raw Water Tariff W per mt	32.88	31.85	31.88	35.05	37.09	38.05	41.65	39.94	42.51	41.76
Treated Water Tariff W per mt	74.54	78.43	73.77	81.14	86.87	88.11	96.42	92.47	98.44	98.70
Total Average Tariff per mt	33.89	33.44	33.86	37.73	40.52	42.38	48.04	50.44	55.00	55.14
Raw Water Revenues	30011	32270	35683	40288	45543	46987	52598	58507	68365	69785
Treated Water Revenues	2087	2875	4131	5761	7986	10309	16094	33868	44154	52037
Other Revenues	0	0	0	0	0	0	0	0	0	0
TOTAL OPERATING REVENUES	32098	34845	39814	46028	53530	57305	68692	92364	110518	121822
Personnel	2875	3338	3463	3708	4001	4379	5686	6238	6845	7528
Power	13937	14743	16108	17210	18348	20847	23298	31548	38558	42538
Materials & Chemicals	337	377	498	567	680	808	1034	1742	2045	2378
Maintenance	556	894	733	770	815	874	941	1092	1175	1268
Raw Water	1383	2083	4287	4588	5158	5554	6197	8372	9893	11288
Other Cost	672	897	821	1024	1084	1163	1252	1428	1535	1658
Administration	839	1464	1404	1503	1622	1775	1987	2174	2386	2624
Seoul Gang Expenses	0	0	0	2080	2308	2850	3525	4527	5444	6302
TOTAL OPERATING EXPENSES	20379	23774	27412	31451	35013	38250	43900	57118	68878	75580
INCOME BEFORE DEPRECIATION	11719	11171	12402	14578	18517	19055	24792	35245	44640	46282
Depreciation	5533	5672	8064	7235	8815	9015	11358	15441	17888	18793
OPERATING INCOME	6186	5499	8338	7343	9901	10040	13454	19804	26974	27489
Non-cash Expenses (deferred)	0	802	276	133	0	0	0	0	0	0
Operational Interest	1144	1189	1190	2198	2886	2725	3088	8811	8519	7634
Other Income (net)	680	1189	1371	1000	1000	1000	1000	1000	1000	1000
Taxes	588	1137	1083	1080	1498	1849	2299	3712	4983	6788
NET INCOME	5154	3760	5130	4981	6517	6466	9056	8281	14472	14047
RATIOS AND COMPARATORS:										
Cost per m3 of water sold	21.52	22.75	23.31	25.78	26.50	26.28	30.70	31.19	32.88	34.20
Working Ratio	63.5%	68.0%	69.8%	69.3%	65.4%	66.7%	63.9%	61.8%	59.4%	62.0%
Operating Ratio	80.7%	86.0%	84.8%	84.3%	81.5%	82.5%	80.4%	78.6%	75.6%	77.5%
Net Income on Revenues	16.1%	10.7%	13.0%	10.8%	12.2%	11.3%	13.2%	9.0%	13.1%	11.5%
Increases in Tariffs		-1.3%	1.2%	11.4%	7.4%	4.6%	13.3%	5.0%	9.0%	0.3%
Increase in Operating Revenues		8.5%	13.8%	15.6%	16.3%	7.1%	19.9%	34.5%	19.7%	10.2%
Increase in Water Sold		10.3%	12.5%	3.7%	8.3%	2.3%	5.8%	28.1%	9.7%	9.8%
Average Asset's Rate Base	182253	188513	194820	195810	198027	200803	289080	398085	539485	549377
Rate of Return on Revalued Assets	3.4%	2.9%	3.3%	3.7%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%

1] Due to rounding, the last digit in totals may appear different than the sum of columns.

12-Jul-88

ISWACO - WATER DIVISION. ANNEX 7
TABLE 2

SOURCES AND APPLICATIONS OF FUNDS Million Won

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
SOURCES OF FUNDS										
Income before depreciation	11719	11171	12402	14578	18517	19055	24792	35245	44840	46282
Other Income [+] or Expenditures	112	52	288	-60	-498	-849	-1299	-2712	-3983	-5788
GROSS INTERNAL CASH GENERATION	11831	11223	12690	14517	18019	18206	23493	32533	40857	40474
Operational Grants [Geum Gang]				750						
Equity Nsagang Project				434	14069	11778	0	0		
Equity Metropolitan Project		0	0	22570	39325	42983	28350	0	0	0
BORROWING:										
Proposed IBRD Loan	0	0	0	0	2075	4704	3760	1600	0	0
IBRD 2491-KO [Metropolitan]	0	0	0	7712	19279	23135	19279	0	0	0
Other Loans	550									
TOTAL BORROWING	550	0	0	7712	21354	27839	23039	1600	0	0
TOTAL SOURCES OF FUNDS	12381	11223	12690	45983	92768	100803	74882	34133	40857	40474
APPLICATIONS OF FUNDS										
Nsagang Project				434	16144	16480	3272	0		
Interest Capitalized	0	0	0	538	2167	4208	5722	482	0	0
Metropolitan Project				29744	58584	62358	42887	0		
Other Water Works	50	4015	2740	2800	500	400	1500	4500	2500	5000
Invest.becoming deferred expenses	190									
TOTAL CAPITAL EXPENDITURES	240	4015	2740	33515	75505	83445	53191	4982	2500	5000
Amortization	1000	1073	1274	1634	2038	2201	3018	9498	10205	10422
Operational Interest	1144	1199	1180	2188	2888	2725	3098	8811	8519	7834
TOTAL DEBT SERVICE	2144	2272	2484	3822	4926	4926	6117	18307	18724	18058
WORKING CAPITAL NEEDS	1040	277	190	190	317	271	925	2122	1504	1209
OTHER ASSETS/LIABIL.NEEDS 1]	-430	316	10554	18884	14580	9610	-460	4450	-690	0
TOTAL APPLICATIONS OF FUNDS	2994	6880	15848	56401	95327	98252	58773	29871	22038	24264
CASH INCREASE [+] OR DECREASE	9387	4343	-3258	-10418	-2561	2551	15110	4262	18819	16210
Debt Service Ratio	5.5	4.9	5.2	3.8	3.7	3.7	3.8	1.8	2.2	2.2
% Contribution to Investment	3782.1%	208.2%	-18.9%	-25.0%	-2.4%	4.1%	31.8%	153.3%	852.8%	424.2%
% Capital expend. of Net Assets	0.1%	2.1%	1.4%	12.4%	27.5%	29.9%	12.9%	0.9%	0.5%	0.8%

1] Includes cash transfers to the Dams Division

12-Jul-85

ISWACO - WATER DIVISION.

ANNEX 7
TABLE 3

BALANCE STATEMENT

Million Won

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Fixed Assets in Operation	192119	209083	212025	295706	308887	323736	471910	611660	642097	676690
Accumulated Depreciation	9868	14310	17157	24757	34424	45049	58493	76668	98118	121915
NET FIXED ASSETS	182253	194773	194868	270950	274462	278688	413417	534992	543979	554775
WORK IN PROGRESS	256	18	1065	30715	105820	188665	111856	1848	2548	5748
Cash & Banks	16028	20371	17113	6885	4134	6685	21795	26057	44876	61085
Accounts Receivable	3101	3378	3870	4652	5353	5731	6869	9236	11052	12182
Inventories	246	784	838	859	902	952	1104	1165	1229	1303
Other Current Assets	5	2	55	60	63	68	70	74	78	83
TOTAL CURRENT ASSETS	19380	24535	21876	12265	10452	13433	29838	36532	57235	74653
DEFERRED EXPENSES	1203	1100	133	0	0	0	0	0	0	0
OTHER ASSETS & LOANS TO DAMS DIV.	26	26	10890	30690	45890	55890	55890	60890	60890	60890
TOTAL ASSETS	203118	220454	228632	344620	436224	536477	610802	634062	664452	695866
Accounts Payable	1288	1823	1320	1660	2290	2450	2820	3130	3510	3510
Other Current Liabilities	0	0	912	1000	1000	1000	1000	1000	1000	1000
Current Matur.Long-Term Debt	1073	1222	1368	2038	2201	3018	9496	10205	10422	10422
TOTAL CURRENT LIABILITIES	2361	3045	3600	4698	5491	6468	13316	14335	14832	14832
Severance Reserve & Insurance	3160	2848	2854	4070	4490	4890	5340	5890	6580	6580
Long-Term Debt [net]	14058	15786	13875	39267	58420	83241	98783	88179	77757	67335
TOTAL LIABILITIES	19577	21677	20229	48236	68401	94588	115440	108403	99288	88847
Assets Revaluation Surplus	42483	42780	46050	48871	59839	69832	83695	103006	124710	148404
Operational Surplus [+]	7033	10783	15943	20904	27421	33868	42944	51225	65698	79744
Capital	134045	145214	146410	226810	281563	338168	368723	371428	374776	378871
TOTAL EQUITY	183541	198777	208403	296385	367823	441888	495362	525658	565183	607019
TOTAL EQUITY AND LIABILITIES	203118	220454	228632	344620	436224	536477	610802	634062	664452	695866
Current Ratio	8.2	8.1	6.1	2.5	1.9	2.1	2.2	2.5	3.8	5.0
Working Capital, exclud. cash	2064	2341	2531	2711	3628	3298	4224	6345	7849	9058
% Debt on Debt plus Equity	7.6%	7.9%	6.7%	12.2%	14.1%	16.3%	17.7%	15.8%	13.5%	11.4%
# Days Accounts Receivable	35	35	35	37	37	37	37	37	37	37
% Debt/[Net Fixed Assets +WIP]	8%	9%	8%	14%	18%	18%	20%	18%	16%	14%

12-Jul-85

ISWACO - WATER DIVISION.

ANNEX 7
TABLE 4

FINANCING PLAN

Million Won

	TOTAL	%	1985	1986	1987	1988	1989
Income Before Depreciation	112187	44.8%	14578	18517	19055	24792	35245
Other Income [+] or Expenditures	-5419	-2.2%	-60	-498	-849	-1299	-2712
GROSS INTERNAL CASH GENERATION	106768	42.6%	14517	18019	18208	23493	32533
MINUS:							
Amortization	18388	7.3%	1634	2039	2201	3018	9496
Operational Interest	19709	7.9%	2188	2886	2725	3099	8811
TOTAL DEBT SERVICE	38097	15.2%	3822	4925	4926	6117	18307
WORKING CAPITAL NEEDS [+]	3814	1.5%	180	317	271	825	2122
OTHER ASSETS [+] OR LIABILITIES NEEDS	47064	18.8%	18884	14580	9610	-460	4450
CASH INCREASE [+] OR DECREASE	8944	3.6%	-10418	-2561	2551	15110	4282
NET INTERNAL CASH GENERATION	8849	3.5%	2050	757	848	1802	3392
CAPITAL EXPENDITURES							
Namgang Project	38329	14.5%	434	16144	18480	3272	0
Interest Capitalized	13128	5.2%	538	2167	4208	5722	492
Metropolitan Project	191383	76.4%	29744	58594	82358	42897	0
Other Works	9800	3.8%	2800	600	400	1500	4500
Investment to become deferred expenses	0	0.0%	0	0	0	0	0
TOTAL CAPITAL EXPENDITURES	250648	100.0%	33515	75505	83445	53191	4992
NET TO BE FINANCED:	241799	96.5%	31465	74747	82597	51389	1600
FINANCED BY:							
Proposed IBRD loan	12139	4.8%	0	2075	4704	3760	1600
IBRD 2491-KO [Metropolitan]	69404	27.7%	7712	19279	23135	19279	0
Other Loans	0	0.0%	0	0	0	0	0
TOTAL BORROWING	81543	32.5%	7712	21354	27839	23038	1600
Operational Grants	750	0.3%	750	0	0	0	0
Equity Contributions	159506	63.6%	23004	53393	54758	28350	0
TOTAL FINANCED	241799	96.5%	31465	74747	82597	51389	1600

12-Jul-85

ISWACO - WATER DIVISION.

ANNEX 7
TABLE 5

MONITORING INDICATORS

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
DEMAND										
Raw Water Sold - Million mt	918	1010	1120	1149	1228	1235	1283	1465	1581	1671
Treated Water Sold - Million mt	28	35	56	71	83	117	167	366	449	538
Total Water Sold -Million mt	947	1045	1176	1220	1321	1352	1430	1831	2010	2209
Water Production - Million mt	997	1100	1238	1284	1391	1423	1505	1928	2115	2325
MANAGEMENT:										
# Days Accounts Receivable	35	35	35	37	37	37	37	37	37	37
Number of Employees	520	565	600	720	720	720	830	830	830	830
% Increase # of employees		8.7%	6.2%	20.0%	0.0%	0.0%	15.3%	0.0%	0.0%	0.0%
% Personnel Cost on Total	13%	14%	13%	12%	11%	11%	13%	11%	10%	10%
FINANCIAL										
Raw Water Tariff W/mt	32.68	31.95	31.88	35.05	37.09	38.05	41.85	39.94	42.51	41.78
Treated Water Tariff W/mt	74.54	76.43	73.77	81.14	85.87	88.11	96.42	92.47	98.44	96.70
Total Average Tariff W/mt	33.9	33.4	33.9	37.7	40.5	42.4	48.0	50.4	55.0	55.1
Increase Total Average Tariff		-1.3%	1.2%	11.4%	7.4%	4.6%	13.3%	5.0%	9.0%	0.3%
Working Ratio	63.5%	68.0%	68.9%	68.3%	65.4%	68.7%	63.9%	61.8%	59.4%	62.0%
Rate of Return	3.4%	2.9%	3.3%	3.7%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Debt Service ratio	5.5	4.9	5.2	3.8	3.7	3.7	3.8	1.8	2.2	2.2
Debt on Debt plus Equity	8%	8%	7%	12%	14%	16%	18%	16%	13%	11%
1984 CONSTANT PRICE ANALYSIS:										
Raw Water tariff [W/mt]	35.09	32.81	31.88	34.04	34.72	33.85	35.11	31.92	32.21	29.82
Treated Water Tariffs [W/mt]	80.09	78.49	73.77	78.82	80.40	78.38	81.30	73.90	74.57	69.27
Salary 000/employee/year	429	482	491	500	520	541	583	585	609	633
Operational Expend./mt Sold	21.5	22.8	23.3	25.8	28.5	28.3	30.7	31.2	32.7	34.2

CRITICAL FINANCIAL INDICATORS FOR THE PERIOD 1985-1991:

VARIABLE OR INDICATOR	MINIMUM	AVERAGE	MAXIMUM	VARIABLE OR INDICATOR	MINIMUM	AVERAGE	MAXIMUM
Cash	4134	24475	81085	Debt Service Ratio	1.8	3.0	3.8
Raw Water Tariff, constant prices	29.8	33.1	35.1	Treated Tariff, constant prices	69.3	76.7	81.3
Working Ratio	59.4%	64.0%	68.3%	Days Accounts Receivable	37	37	37
Rate of Return	3.7%	4.8%	5.0%	Debt/[debt + equity]	11.4%	14.4%	17.7%

12-Jul-85

ISWACO - DAMS DIVISION.

Annex 8

TABLE 1

INCOME STATEMENT 1] Million Won

Fy ends 12/31

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
SALES OF SERVICES:										
Mun.& Ind.Water Rights Mill.Tons	1017	1048	1284	1318	1409	1538	1895	2087	2319	2553
Power sales, GWH	614	691	686	1058	1519	1518	1747	1745	1743	1741
Irrigated Land, ha	140	191	633	5200	6300	7400	8500	9600	10700	11000
AVERAGE RATES:										
Mun.& Ind. Water Rights W/mt	1.89	2.68	4.20	4.73	5.46	6.14	6.73	8.25	8.68	8.86
Power, W/KWH	13.82	20.72	23.56	27.86	34.58	38.61	41.79	50.91	53.31	54.28
Irrigated Land, W Million/ha	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03
REVENUES										
Municipal & Ind. Water	1918	2810	5436	6230	7698	9448	12744	17224	20117	22831
Power sales	8484	14318	16165	29418	52501	58538	73008	88835	92823	94505
Irrigated Land Rights	3	4	13	112	151	195	232	313	358	367
Other Revenues	0	0	0	0	0	0	0	0	0	0
TOTAL OPERATING REVENUES	10405	17132	21614	35759	60348	68179	85984	106371	113399	117503
Personnel	2254	2531	2428	2960	3548	3885	5541	6547	7183	7882
Power	498	483	423	479	512	580	650	686	760	842
Maintenance	346	380	359	517	591	622	721	781	883	1025
Other direct expenses	640	811	599	802	873	927	1017	1073	1245	1444
Administration	1029	1061	859	1017	1219	1335	1904	2248	2468	2708
TOTAL OPERATING EXPENSES	4767	5246	4668	5775	6744	7328	9832	11318	12538	13900
INCOME BEFORE DEPRECIATION	5638	11886	16946	29984	53604	60851	76151	95056	100860	103603
Depreciation	5053	6488	7983	12631	19653	22603	28475	35750	38549	40352
OPERATING INCOME	585	5398	8963	17353	33951	38248	47676	59306	62311	63251
Non-cash Expenses [deferred]	0	91	352	400	400	400	400	400	400	400
Operational Interest	2513	2536	2392	5955	15906	15030	25340	25200	23166	20486
Other Income [net]	0	776	982	1000	1000	1000	1000	1000	1000	1000
Taxes	238	524	598	198	686	789	1227	1311	1928	2772
NET INCOME	-2166	3023	6803	11800	17959	23030	21709	33395	37816	40583
RATIOS AND COMPARATORS										
Working Ratio	45.8%	30.6%	21.6%	16.2%	11.2%	10.7%	11.4%	10.6%	11.1%	11.8%
Operating Ratio	94.4%	69.0%	60.2%	52.6%	44.4%	44.5%	45.0%	44.6%	45.4%	46.5%
Net Income on Revenues	-20.8%	17.6%	30.5%	33.0%	29.8%	33.8%	25.2%	31.4%	33.3%	34.5%
Increase in Operating Revenues		64.7%	26.2%	65.4%	68.8%	13.0%	26.1%	23.7%	6.6%	3.6%
Increase in Power Sold		12.6%	-0.7%	53.9%	43.9%	-0.2%	15.2%	-0.1%	-0.1%	-0.1%
Average Asset's Rate Base	176090	228469	274848	438186	679028	784665	953527	1186120	1248210	1285020
Rate of Return on Revalued Assets	0.3%	2.4%	3.3%	4.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%

1] Due to rounding, the last digit in totals may appear different then the sum of columns.
30-Apr-85

Annex 8

ISWACO - DAMS DIVISION.

TABLE 2

SOURCES AND APPLICATIONS OF FUNDS

Million Won

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
SOURCES OF FUNDS:										
Income before depreciation	5638	11888	16946	29984	53604	60851	76151	95056	100860	103603
Other income (+) or Expenses	-238	252	384	802	314	211	-227	-311	-928	-1772
Land reclamation, (Nakdong)	0	0	0	0	0	19640	28057	32882	4000	0
GROSS INTERNAL CASH GENERATION	5400	12138	17330	30786	53918	80703	103981	127428	103831	101830
Chungju	97472	104174	28010	45896						
Nakdong			9802	20900	14300	3100				
Hapcheon			7666	13031	14400	1500				
Juam and Others		1637	1091	21011	57602	60023	56242			
TOTAL EQUITY CONTRIBUTIONS	97472	105811	46569	100838	86302	64623	56242	0	0	0
BORROWING										
IBRD-Nakdong (2350 KD)	0	0	6124	28849	17822	4821	4000	0	0	0
OECF - Hapcheon	0	4301	9761	5250	28115	7137	0	0	0	0
OECF - Juam	0	0	0	7800	11489	8316	5698	0	0	0
KDB LOANS	0	0	48000	27600	0	0	0	0	0	0
Oil Fund	0	33900	0	0	0	0	0	0	0	0
IBRD (1688 KD) - Chungju Dam	15355	19807	11606	640				0	0	0
OECF - Chungju	12576	5888	7305	12464						
Other Loans									10000	14000
TOTAL BORROWING	27931	63896	82796	82602	57235	20274	9698	0	10000	14000
TOTAL SOURCES OF FUNDS	130803	181845	146695	214226	197456	165599	169921	127428	113931	115830
APPLICATIONS OF FUNDS:										
Nakdong Barrage	2093	4677	18867	59252	35000	12400				
Interest Capitalized	7290	6854	16586	20837	15745	17973	6106	1714	1714	1690
Chungju Dam	160324	153574	86354	53938						
Hapcheon Dam	0	265	24877	72192	57650	22369				
Other and Juam Dam	72	2068	1670	20724	65000	67624	65000	20000	20000	20000
Invest.to become defer.expenses	190	68		1330						
TOTAL CAPITAL EXPENDITURES	169969	167508	148354	228273	173395	120368	71106	21714	21714	21690
Amortization	4152	12120	13936	16181	16219	25860	39358	41786	42577	43786
Operational Interest	2513	2538	2392	5955	15906	15030	25340	25200	23166	20486
TOTAL DEBT SERVICE	6665	14656	16328	22136	32125	40890	64695	66986	65743	64252
WORKING CAPITAL NEEDS (+)	-1000	-1854	-4440	-10037	8338	7422	6204	7415	510	554
OTHER ASSETS/LIABIL.NEEDS (+)	0	0	-10000	-20000	-15000	-10000	0	-5000	0	0
TOTAL APPLICATIONS OF FUNDS	175634	180308	150242	220372	193858	158878	142006	91115	87967	86497
CASH INCREASE (+) OR DECREASE	-44831	1537	-3548	-6146	-1400	8922	27916	36312	25964	29334
Dabt Service Ratio	0.8	0.8	1.1	1.4	1.7	2.0	1.6	1.9	1.8	1.6
% Contribution to Investment	-0.2%	-0.4%	10.4%	18.9%	16.4%	35.2%	46.5%	267.2%	173.5%	170.7
% Capital expend. of Net Assets	98.5%	60.5%	54.4%	38.1%	22.9%	15.6%	8.3%	1.8%	1.7%	1.7

30-Apr-85

ISWACO - DAMS DIVISION.

Annex 8

TABLE 3

BALANCE STATEMENT

Million Won

Fy ends 12/31

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Fixed Assets in Operation	187140	293443	297908	637743	818034	856277	1252987	1395142	1460365	1528637
Accumulated Depreciation	11050	16595	25058	38222	59499	84884	117327	158562	204524	254437
NET FIXED ASSETS	176090	276848	272848	599521	758535	771394	1135660	1236580	1255841	1274200
WORK IN PROGRESS	169779	336742	484324	310989	306720	427086	79954	0	21714	43404
Cash	10164	11701	8155	2009	609	7530	35448	71758	97722	127056
Accounts Receivable	900	5480	3659	3585	6035	6818	8598	10637	11340	11750
Inventories	1309	996	979	1126	1372	1454	1696	1798	1908	2000
Other Current Assets	794	1894	161	575	610	648	685	726	770	820
TOTAL CURRENT ASSETS	13167	20081	12954	7295	8625	16448	46425	84919	111738	141626
DEFERRED EXPENSES	11717	11694	11342	12272	11872	11472	11072	10672	10272	9872
OTHER FIXED ASSETS(NOT FOR ROR)	0	0	0	70278	97942	97942	167648	187648	187648	187648
OTHER ASSETS										
TOTAL ASSETS	370753	645365	781468	930077	1085753	1226400	1273112	1332171	1399565	1469102
Accounts Payable	1443	1831	44	1013	1382	1492	1837	2004	2348	2348
Contractor's Payable	5848	12691	15337	24892	18918	12287	7800	2400	2400	2400
Current Matur.Long-Term Debt	8144	13936	16181	16219	25860	39356	41786	42577	43768	0
TOTAL CURRENT LIABILITIES	15435	28458	31562	42124	46160	53135	51423	46981	48515	4749
Loan from the Water Division			10000	30000	45000	55000	55000	60000	60000	60000
Long-Term Debt (net)	122961	168945	235560	301944	333319	314236	282149	239572	205805	219805
TOTAL LIABILITIES	138396	197403	277122	374068	424479	422371	388572	346553	314321	284554
Assets Revaluation Surplus	25662	148444	147802	153071	177162	207121	244662	291527	339504	386580
Operational Surplus (+)	-3966	-543	5660	17480	35419	58449	80158	113552	151369	191961
Capital	200829	300462	350883	385479	448693	538459	559721	580538	594371	606006
TOTAL EQUITY	222525	447962	504345	556010	661274	804028	884540	985618	1085244	1184547
TOTAL EQUITY AND LIABILITIES	370753	645365	781468	930077	1085753	1226400	1273112	1332171	1399565	1469102
Current Ratio	0.9	0.7	0.4	0.2	0.2	0.3	0.9	1.8	2.3	29.8
Working Capital, exclud. cash	-4288	-6142	-10582	-20619	-12283	-4861	1342	8757	9267	9821
% Debt on Debt plus Equity	37.1%	29.0%	33.3%	36.4%	35.2%	30.5%	26.8%	22.3%	18.7%	15.7%
# Days Accounts Receivable	32	117	62	37	37	37	37	37	37	37
% Debt/(Net Fixed Assets +WIP)	38%	30%	33%	35%	34%	30%	27%	23%	20%	17%

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ISWACO - DAMS DIVISION. Annex 8

FINANCING PLAN Million Won TABLE 4

	TOTAL	%	1984	1985	1986	1987	1988
Income Before Depreciation	237538	32.0%	16946	29984	53604	60851	76151
Other Income	1484	0.2%	384	802	314	211	-227
User's Contributions	47697	6.4%	0	0	0	19640	28057
GROSS INTER.CASH GENERATION	286718	38.7%	17330	30786	53918	80703	103981
MINUS:							
Amortization	111552	15.0%	13938	16181	16219	25880	39358
Operational Interest	64823	8.7%	2392	5955	15906	15030	25340
TOTAL DEBT SERVICE	176174	23.8%	16328	22136	32125	40890	64695
WORKING CAPITAL NEEDS [+]	7484	1.0%	-4440	-10037	8338	7422	6204
OTHER ASSETS [+] OR LIAB.NEE	-55000	-7.4%	-10000	-20000	-15000	-10000	0
CASH INCREASE [+] OR DECR.	23745	3.2%	-3548	-6148	-1400	6922	27818
NET INTERNAL CASH GENERATION	134315	18.1%	18988	44833	29858	35469	5166
CAPITAL EXPENDITURES							
Nakdong Barrage	125519	16.9%	18867	59252	35000	12400	0
Interest Capitalized	77247	10.4%	16588	20537	15745	17873	6108
Chungju Dam	140292	18.9%	86354	53938	0	0	0
Hapcheon Dam	177088	23.9%	14877	72182	57650	22389	0
Juam Dam and Others	221348	29.9%	1670	22054	65000	67624	65000
TOTAL CAPITAL EXPENDITURES	741494	100.0%	148354	228273	173395	120386	71108
NET TO BE FINANCED:	607180	81.9%	129365	183440	143537	84897	65940
FINANCED BY:							
IBRD-Nakdong (2350 KD)	61415	8.3%	6124	28849	17622	4821	4000
OECF - Hapcheon	50282	6.8%	9781	5250	28115	7137	0
OECF - Juam	33313	4.5%	0	7800	11499	8316	5698
KDB LOANS	75600	10.2%	48000	27600	0	0	0
Oil Fund	0	0.0%	0	0	0	0	0
IBRD [1668 KD] - Chungju Dam	12248	1.7%	11608	640	0	0	0
OECF - Chungju	19789	2.7%	7305	12464	0	0	0
Other Loans	0	0.0%	0	0	0	0	0
TOTAL BORROWING	252808	34.1%	82798	82802	57255	20274	9698
Equity Contributions	354574	47.8%	46569	100838	86302	64623	56242
TOTAL FINANCED	607180	81.9%	129365	183440	143537	84897	65940

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ISWACO - DAMS DIVISION.

Annex 8

TABLE 5

MONITORING INDICATORS

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
DEMAND										
Mun.& Ind. Water Rights-Mill.mt	1017	1048	1294	1318	1409	1539	1895	2087	2319	2553
Power sales - GWH	614	681	686	1056	1519	1516	1747	1745	1743	1741
Irrigated Land, ha	140	191	633	5200	6300	7400	8500	9600	10700	11000
MANAGEMENT:										
# Days Accounts Receivable	32	117	62	37	37	37	37	37	37	37
Number of Employees	389	387	380	450	500	500	650	700	700	700
% Increase # of employees		99.5%	98.2%	118.4%	111.1%	100.0%	130.0%	107.7%	100.0%	100.0%
FINANCIAL										
Average Rates:										
Mun.& Ind. Water Rights W/mt	1.89	2.68	4.20	4.73	5.46	6.14	6.73	8.25	8.68	8.86
Power, W/KWH	13.82	20.72	23.56	27.86	34.56	38.81	41.79	50.91	53.31	54.28
Irrigated Land, W/ha	20880	20880	20880	21486	24018	26307	27307	32804	33466	33398
Working Ratio	45.5%	30.6%	21.6%	16.2%	11.2%	10.7%	11.4%	10.6%	11.1%	11.8%
Contribution to investment	-0.2%	-0.4%	10.4%	16.9%	16.4%	35.2%	46.5%	267.2%	173.5%	170.7%
Rate of Return	0.3%	2.4%	3.3%	4.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Debt Service ratio	0.8	0.8	1.1	1.4	1.7	2.0	1.6	1.9	1.6	1.6
Debt on Debt plus Equity	37%	29%	33%	36%	35%	31%	27%	22%	19%	16%
1984 CONSTANT PRICE ANALYSIS:										
Total Revenues- Million W	11180	17595	21614	34735	56500	60648	72498	85013	85804	84373
Real Increase in Revenues		57.4%	22.8%	60.7%	62.7%	7.3%	19.5%	17.3%	1.0%	-1.8%
Mun.& Ind. Water Rights W/mt	2.03	2.75	4.20	4.58	5.11	5.46	5.67	6.60	6.57	6.37
Power, W/KWH	14.85	21.28	23.56	27.06	32.36	34.35	35.24	40.89	40.39	38.98
Irrigated Land, W/ha	22436	21444	20880	20880	22487	23401	23024	26058	25352	23981
Salary 000/employee/year	483	545	532	532	554	576	599	623	648	674

CRITICAL FINANCIAL INDICATORS BETWEEN 1985-1991

VARIABLE OR INDICATOR	MINIMUN	AVERAGE	MAXIMUN
Cash	608	48878	127056
Power Tariff W/Kwh(const.prices)	27.08	35.58	40.69
Working ratio	10.6%	11.9%	16.2%
Rate of Return	4.0%	4.9%	5.0%

VARIABLE OR INDICATOR	MINIMUN	AVERAGE	MAXIMUN
Debt Service Ratio	1.4	1.7	2.0
Contribution to invest.	16.4%	103.8%	267.2%
Days Accounts Receivable	37	37	37
Debt/(debt + equity)	15.7%	26.5%	38.4%

30-Apr-85

ANNEX 9
Table 1

K O R E A

NAMGANG AND TAEGU WATER SUPPLY PROJECT

ISWACO CONSOLIDATED FINANCIAL STATEMENTS

INCOME STATEMENT

Million Won

	1980	1981	1982	1983
OPERATING REVENUE:				
Water supply	12,232	19,423	32,099	34,945
Dams	6,912	15,189	11,030	18,120
Industrial sites, new cities	60,890	35,931	28,823	41,955
Others	24,530	5,008	1,132	1,967
TOTAL OPERATING REVENUE	104,564	75,551	73,084	96,987
OPERATING EXPENSES:				
Water supply	11,094	18,402	24,943	27,980
Dams	6,325	11,752	12,692	15,312
Industrial sites, new cities	60,771	35,947	28,823	41,955
Others	23,762	4,477	1,264	1,217
TOTAL OPERATING EXPENSES	101,952	70,578	67,722	86,464
GROSS INCOME	2,612	4,973	5,362	10,523
General Administration	2,469	2,880	3,647	3,998
OPERATING INCOME	143	2,093	1,715	6,525
Interest Income	2,963	3,813	4,096	3,493
Amortization of exchange losses	216	997	940	23
Other Income (net).	1,183	1,662	779	985
TOTAL NON-OPERATING INCOME	3,930	4,478	3,935	4,455
INCOME BEFORE INCOME TAXES	4,073	6,571	5,650	10,980
Income Taxes	445	742	806	1,661
NET INCOME	3,628	5,829	4,844	9,319
Net income on equity	2.3%	2.2%	1.5%	1.6%
Taxes on income before taxes	11%	11%	14%	15%

[a] Includes depreciation and operational interest.

Source: ISWACO's Audit Reports

ANNEX 9
Table 2

K O R E A

NAMGANG AND TAEGU WATER SUPPLY PROJECT

ISWACO CONSOLIDATED FINANCIAL STATEMENTS

FLOW OF FUNDS

Million Won

	1980	1981	1982	1983
SOURCES OF FUNDS:				
Net Income	3,628	5,829	4,844	9,319
Non-cash expenditures	7,328	13,661	14,857	18,159
Receipts from development projects	12,692	35,792	31,440	83,150
Increase in advance receipts -net	13,287	(6,946)	7,465	10,147
GROSS INTERNAL CASH CONTRIBUTION	36,935	48,336	58,606	120,775
Local Loans	9,107	5,650		38,502
Foreign Loans	32,140	42,684	17,931	24,137
TOTAL LOANS	41,247	48,334	17,931	62,639
Equity Contributions	3,213	29,936	60,799	104,172
Other -net	(447)	3,259	831	712
TOTAL SOURCES OF FUNDS	80,948	129,865	138,167	288,298
APPLICATIONS OF FUNDS:				
Capital Expenditures	64,946	85,540	92,495	206,361
Capitalized Interest	18,086	20,576	16,692	11,287
TOTAL CAPITAL EXPENDITURES	83,032	106,116	109,187	217,648
Amortization local loans	6,043	10,359	11,217	14,694
Amortization foreign loans	15,525	7,116	9,204	15,603
Operational Interest	1,794	3,851	3,627	3,646
TOTAL DEBT SERVICE	23,362	21,326	24,048	33,943
Payment of severance indemnities	969	115	158	681
Increase in working capital	(26,415)	2,308	4,774	36,026
TOTAL APPLICATIONS OF FUNDS	80,948	129,865	138,167	288,298
% internal contrib. to capital expend	48.2%	23.3%	27.3%	23.3%
% Capital expend. to net fixed assets	62%	31%	35%	49%
Debt service ratio	1.6	2.3	2.4	3.6

Source: ISWACO's Audit Statements

ANNEX 9
Table 3

K O R E A

NAMGANG AND TAEGU WATER SUPPLY PROJECT

ISWACO CONSOLIDATED FINANCIAL STATEMENTS

BALANCE STATEMENT

Million Won

	1980	1981	1982	1983
FIXET ASSETS:				
Dams Division	77,187	191,447	184,835	297,906
Accum. depreciation Dams Division	(12,072)	(14,535)	(19,498)	(15,313)
Water Division	63,286	148,074	148,219	164,969
Accum. depreciation Water Division	(1,528)	(4,160)	(3,429)	(12,854)
Other Fixed Assets (net)	7,817	16,773	4,199	5,943
NET FIXED ASSETS	134,690	337,599	309,326	440,651
Construction in progress	32,619	84,792	169,231	335,697
TOTAL FIXED ASSETS	167,309	422,391	478,557	776,348
Deferred charges	16,378	17,732	19,732	12,809
Other Assets	190,400	187,003	180,767	146,549
CURRENT ASSETS:				
Cash	5,056	17,212	8,617	33,578
Accounts Receivable	5,489	5,982	9,269	10,610
Inventories	842	1,268	2,110	2,194
Other	15,428	11,953	26,776	70,202
TOTAL CURRENT ASSETS	26,815	36,415	46,772	116,584
TOTAL ASSETS	400,902	663,541	725,828	1,052,290
LONG-TERM LIABILITIES:				
Local Loans	66,288	56,628	45,411	69,210
Foreign Loans	53,028	126,241	137,089	151,011
Employees's severance indemnities	5,025	6,476	8,651	10,429
Others	78,533	163,209	151,355	161,303
TOTAL LONG-TERM LIABILITIES	202,874	352,554	342,506	391,953
CURRENT LIABILITIES:				
Accounts payable	11,158	7,607	6,694	17,147
Short-term borrowing	6,100	10,849	12,800	
Current matur. of long-term loans	16,268	23,889	20,598	28,613
Other	7,864	6,336	14,172	42,289
TOTAL CURRENT LIABILITIES	41,390	48,681	54,264	88,049
TOTAL LIABILITIES	244,264	401,235	396,770	480,002
EQUITY:				
Capital	120,383	219,383	280,182	398,645
Revaluation surplus	25,617	25,663	25,663	141,346
Other surplus	171	211	211	785
Retained earnings	10,467	17,049	22,642	31,512
TOTAL EQUITY	156,638	262,306	328,698	572,288
TOTAL EQUITY AND LIABILITIES	400,902	663,541	725,468	1,052,290
Current ratio	0.65	0.75	0.86	1.32
Debt to Debt plus Equity	56.4%	57.3%	51.0%	40.6%

Source: Audit Reports

ANNEX 10
TABLE 1

TAEGU WATER SUPPLY BUREAU

INCOME STATEMENT 1] Million Won

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Population - Thousand	1904	1958	2033	2106	2182	2261	2342	2426	2514	2604
% Population Served	91.0%	92.0%	94.0%	94.0%	94.3%	94.6%	95.5%	97.0%	97.5%	98.0%
Population Served - Thousand	1733	1802	1910	1980	2058	2138	2237	2353	2451	2552
Water Connections - Thousand	188.1	198.0	210.3	217.6	228.1	235.0	245.8	258.6	269.3	280.4
Water Sold, liters/capita/day	135	148	159	167	175	185	195	203	211	218
Water Sold [Million Tons]	85.22	95.97	110.91	120.71	131.43	144.40	159.19	174.38	188.75	203.06
Water Sold Tons/month/connection	37.7	40.4	43.9	46.2	48.4	51.2	54.0	56.2	58.4	60.3
% Unaccounted-for Water	33.7%	34.7%	38.0%	38.0%	36.0%	34.0%	33.0%	32.0%	31.0%	31.0%
Water Production - Million mt	128.5	147.0	178.8	184.7	205.4	218.8	237.6	256.4	273.5	294.3
Water Tariff Won per Ton	153.20	168.31	183.81	189.14	218.64	219.28	234.06	244.55	245.71	243.12
Water Revenues	13058	16153	21496	24039	28736	31667	37280	42644	46376	49388
House Connection Charges	7600	3456	3842	3792	3941	4096	4283	4507	4694	4888
Other Revenues	1078	1099	1197	1230	1314	1482	1762	2211	2927	4088
TOTAL OPERATING REVENUES	21734	20708	26535	29061	33991	37244	43305	49362	53997	58344
Personnel	2540	2906	3174	3413	3705	4041	4570	4895	5906	6472
Power	3412	3834	4846	5200	5707	6419	7359	8388	9443	10726
Chemicals	282	254	452	505	554	623	714	813	915	1039
Materials & Maintenance	2303	2124	2127	2238	2382	2593	2823	3087	3352	3639
Raw Water	67	84	272	304	334	375	430	489	551	625
Other Expenses	892	844	1277	1330	1405	1506	1618	1742	1869	2004
House Connections Costs	6936	3507	3447	3792	3941	4096	4283	4507	4694	4888
TOTAL OPERATING EXPENSES	16432	13553	15385	16783	18038	19852	21797	24020	26729	29391
INCOME BEFORE DEPRECIATION	5302	7155	11140	12278	15952	17592	21508	25342	27268	28953
Depreciation	1195	1704	2487	4130	4738	5103	6273	7840	8358	9033
OPERATING INCOME	4107	5451	8653	8148	11214	12488	15235	17702	18913	19920
Operational Interest	1267	2858	5845	4946	4822	5193	5497	5956	4555	4323
Other Income [nec]	380	371	425	200	200	200	200	200	200	200
Amortization Deferred Expenses	189	419	251	100	80	80	80	80	80	90
Debt Revaluation Losses		545	471							
Other Non-cash Expenses [Net]	28	288								
NET INCOME	3003	2159	2982	3303	6713	7419	9858	11888	14478	15717
RATIOS AND COMPARATORS										
Cost per Ton of water sold	192.82	141.22	138.81	139.03	137.24	136.09	136.93	137.75	141.61	144.74
Working Ratio	75.6%	65.4%	58.0%	57.8%	53.1%	52.8%	50.3%	48.7%	49.5%	50.4%
Operating Ratio	82.0%	75.7%	68.3%	72.3%	67.2%	66.7%	65.0%	64.3%	65.1%	66.0%
Net Income on Revenues	13.8%	10.4%	11.2%	11.4%	19.7%	19.9%	22.8%	24.0%	26.8%	26.9%
Water Tariff Increase		9.8%	15.2%	2.8%	9.8%	0.3%	6.7%	4.5%	0.5%	-1.1%
Increase in Operating Revenues		-4.7%	28.1%	9.5%	17.0%	9.6%	16.3%	14.0%	9.4%	8.0%
Increase in Water Sold		12.6%	15.6%	8.8%	8.8%	9.8%	10.2%	9.6%	8.2%	7.6%
Average Asset's Rate Base	62812	71184	97720	126339	140181	146931	161372	221271	238410	249002
Rate of Return on Revalued Assets	8.5%	7.7%	8.9%	8.4%	8.0%	8.5%	8.4%	8.0%	8.0%	8.0%

1] Due to rounding, the last digit in totals may appear different than the sum of columns.

12-Jul-85

ANNEX 10
TABLE 2

TAEGU WATER SUPPLY BUREAU

SOURCES AND APPLICATIONS OF FUNDS

Million Won

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
					SOURCES OF FUNDS					
Income before depreciation	5302	7155	11140	12278	15952	17592	21508	25342	27268	28953
Other income	380	371	425	200	200	200	200	200	200	200
Sale of Assets	14	347	691	0	0	0	0	0	0	0
User's Contributions	1146	1192	2808	1100	1100	1100	1100	1100	1100	1100
Developer's Contributions	4960	947	988	500	500	500	500	500	500	500
GROSS INTERNAL CASH GENERATION	11802	10012	15852	14078	17752	19392	23308	27142	29068	30753
Equity Contributions	1530									
BORROWING										
Proposed IBRD loan	0	0	0	0	3154	5758	6080	3520	0	0
Government Loan	1800	3000	4000	3000	3430	2060	950	2940	3620	2870
City Bonds	4000	11000	6000	4030	4181	5127	5063	1602	2582	3373
Other Loans	7235	11245	5030							
TOTAL BORROWING	13035	25245	15030	7030	10765	12945	12093	8062	6202	6243
TOTAL SOURCES OF FUNDS	26367	35257	30881	21108	28517	32337	35401	35204	35270	36996
					APPLICATIONS OF FUNDS					
Proposed Project				2688	18051	18112	14389			
Interest Capitalized	0	0	40	311	1132	2105	2974	2704	2026	1931
Other Water Works	12409	27611	21482	6263						
Rehabilitation & Leak Detection			2100	1710	1000	1000	1000	1000	2250	300
Geumho System				294			1566	6700	6395	6925
Other Assets		688								
Contributed Assets	4960	947	988	500	500	500	500	500	500	500
Invest.transfered to deferred exp	292									
TOTAL CAPITAL EXPENDITURES	17681	29246	24610	11766	20683	21717	20429	10904	11171	9658
Amortization	208	684	1931	9337	5034	6985	9169	12927	9410	9899
Operational Interest	1267	2956	5845	4846	4622	5193	5487	5958	4555	4323
TOTAL DEBT SERVICE	1475	3620	7776	14283	9658	12178	14887	18884	13965	14023
WORKING CAPITAL NEEDS 1/	6935	-1000	-180	-54	-757	74	334	1182	219	397
OTHER ASSETS/LIABIL. CHANGES	279	1	3	0	0	0	0	0	0	0
TOTAL APPLICATIONS OF FUNDS	26350	31887	32209	25996	28582	33968	35430	30870	25355	24075
CASH INCREASE (+) OR DECREASE	17	3390	-1328	-4888	-1065	-1631	-29	4234	9915	12920
Debt Service Ratio	8.0	2.8	2.0	1.0	1.8	1.6	1.6	1.4	2.1	2.2
% Contribution to Investment	17.6%	25.3%	33.5%	-1.3%	42.8%	32.9%	40.7%	84.9%	133.2%	188.2%
% Capital expend. of Net Assets	28.1%	36.8%	21.2%	8.6%	14.4%	14.4%	9.6%	4.7%	4.6%	3.8%

1/ Excluding Cash and Current Maturities

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TAEGU WATER SUPPLY BUREAU

ANNEX 10
TABLE 3

BALANCE STATEMENT

Million Won

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Fixed Assets in Operation	74859	93306	132122	162847	175577	188902	259136	286601	310233	334870
Accumulated Depreciation	12047	13751	16238	26053	32009	38608	46685	56508	67506	79695
NET FIXED ASSETS	62812	79555	115884	136794	143568	150294	212450	230093	242728	255276
WORK IN PROGRESS	10158	20608	5711	13477	29160	45877	6306	2210	3382	3038
Cash & Banks	5975	9385	8037	3149	2084	453	424	4659	14574	27494
Accounts Receivable	101	143	330	481	544	631	734	848	969	1099
Inventories	298	278	624	895	957	1037	1129	1235	1341	1455
Advances & Securities	695	86	71	80	90	100	110	120	140	140
Other Current Assets	4298	2461	2527	2000	2000	2000	2000	2000	2000	2000
TOTAL CURRENT ASSETS	11367	12333	11589	6605	5675	4221	4398	8862	19023	32188
DEFERRED EXPENSES	1160	741	490	390	310	230	150	70	-10	-90
OTHER ASSETS	13	14	17	17	17	17	17	17	17	17
TOTAL ASSETS	85508	113251	133691	157283	178731	200639	223321	241252	265139	290429
Accounts Payable	1648	312	345	588	1034	1086	1021	545	559	483
Other Current Liabilities	206	118	849	563	1009	1061	996	520	534	458
Current Matur.Long-Term Debt	218	1928	9998	5034	6985	9169	12827	9410	9698	9699
TOTAL CURRENT LIABILITIES	2072	2358	11192	6186	9028	11316	14945	10475	10791	10640
Other Liabilities	0	0	0	0	0	0	0	0	0	0
Long-Term Debt [net]	22478	50286	55784	58440	62220	65896	65162	63814	60317	56961
TOTAL LIABILITIES	24548	52642	66976	64626	71248	77312	80107	74290	71108	67500
Assets Revaluation Surplus	35884	35884	35884	52448	58980	65789	74217	84500	95491	107072
Operational Surplus [+]	4732	6891	9873	13176	19889	27305	37163	49028	63507	79223
Capital	20344	17834	20959	27034	28634	30234	31834	33434	35034	36634
TOTAL EQUITY	60960	60809	66716	92658	107482	123327	143214	166962	194031	222929
TOTAL EQUITY AND LIABILITIES	85508	113251	133691	157283	178731	200639	223321	241252	265138	290429
Current Ratio	5.5	5.2	1.0	1.1	0.6	0.4	0.3	0.8	1.8	3.0
Working Capital, exclud. cash	3538	2538	2358	2304	1546	1822	1955	3138	3357	3754
% Debt on Debt plus Equity	27.1%	46.3%	49.6%	40.7%	39.2%	37.8%	35.3%	30.5%	26.5%	23.0%
# Days Accounts Receivable	2	3	5	6	6	6	6	6	7	7
% Debt/[Net Fixed Assets +WIP]	31%	52%	54%	42%	40%	38%	36%	32%	28%	26%

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TAEGU WATER SUPPLY BUREAU

ANNEX 10
TABLE 4

FINANCING PLAN

Million Won

	TOTAL	% OF TOTAL	1985	1986	1987	1988
Income Before Depreciation	67330	90.3%	12278	15952	17592	21508
Other Income	800	1.1%	200	200	200	200
User's Contributions	4400	5.9%	1100	1100	1100	1100
Developer's Contributions	2000	2.7%	500	500	500	500
GROSS INTERNAL CASH GENERATION	74530	99.9%	14078	17752	19392	23308
MINUS:						
Amortization	30526	40.9%	9337	5034	6985	9169
Operational Interest	20258	27.2%	4946	4822	5193	5497
TOTAL DEBT SERVICE	50783	68.1%	14283	9856	12178	14667
WORKING CAPITAL NEEDS (+)	-403	-0.5%	-54	-757	74	334
OTHER ASSETS (+) OR LIAB.NEEDS	0	0.0%	0	0	0	0
CASH INCREASE (+) OR DECREASE	-7813	-10.2%	-4888	-1085	-1831	-29
NET INTERNAL CASH GENERATION	31782	42.6%	4736	9918	8771	8336
CAPITAL EXPENDITURES						
Proposed Project	53240	71.4%	2688	18051	18112	14389
Interest Capitalized	6522	8.7%	311	1132	2105	2974
Other Water Works	6283	8.4%	6283	0	0	0
Rehabilitation & Leak Detection	4710	6.3%	1710	1000	1000	1000
Geumho System	1960	2.5%	284	0	0	1586
Other Assets	0	0.0%	0	0	0	0
Contributed Assets	2000	2.7%	500	500	500	500
Invest.becoming deferred expenses	0	0.0%	0	0	0	0
TOTAL CAPITAL EXPENDITURES	74695	100.0%	11768	20683	21717	20429
NET TO BE FINANCED:	42833	57.4%	7030	10765	12945	12093
FINANCED BY:						
Proposed IBRD Loan	14992	20.1%	0	3154	5758	6080
Government Loan	9440	12.7%	3000	3430	2060	950
City Bonds	18401	24.7%	4030	4181	5127	5063
Other Loans	0	0.0%	0	0	0	0
TOTAL BORROWING	42833	57.4%	7030	10765	12945	12093
Equity Contributions	0	0.0%	0	0	0	0
TOTAL FINANCED	42833	57.4%	7030	10765	12945	12093

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TAEGU WATER SUPPLY BUREAU

ANNEX 10
TABLE 5

MONITORING INDICATORS

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
DEMAND										
Population - Thousand	1904	1959	2033	2108	2182	2261	2342	2426	2514	2604
Population Served - Thousand	1733	1802	1910	1980	2058	2138	2237	2353	2451	2552
% Population served	91.0%	92.0%	94.0%	94.0%	94.3%	94.6%	95.5%	97.0%	97.5%	98.0%
Water Connections - Thousand	188.1	198.0	210.3	217.6	226.1	235.0	245.8	258.6	269.3	280.4
Water Sold [lpcd] - Appraisal	135	148	159	167	175	185	195	203	211	219
Water Sold [lpcd] - KECC's Revised Demand				175	185	195	203	211	218	225
Water Sold [lpcd] - City's Forecast				197	178	186	198	207	219	231
Water Sold - Million Ton	85.2	96.0	110.9	120.7	131.4	144.4	159.2	174.4	188.7	203.1
Water Sold -City's Forecast				121.1	132.8	148.3	160.8	176.3	193.8	212.8
Water Production - Million Ton	129	147	179	195	205	219	238	258	274	294
MANAGEMENT:										
# Days Accounts Receivable	2	3	5	6	8	8	6	8	7	7
Number of Employees	735	729	807	820	831	834	888	873	950	958
% Increase # of employees		-0.8%	10.7%	1.6%	1.3%	0.4%	4.1%	0.6%	8.8%	0.8%
Employees /1000 Water Connections	3.9	3.7	3.8	3.8	3.7	3.5	3.5	3.4	3.5	3.4
FINANCIAL										
Average Water Tariff W/Ton	153.20	168.31	193.81	199.14	218.84	219.29	234.08	244.55	245.71	243.12
Increase Water Tariff		9.8%	15.2%	2.8%	9.8%	0.3%	6.7%	4.5%	0.5%	-1.1%
Working Ratio	75.8%	65.4%	58.0%	57.8%	53.1%	52.8%	50.3%	48.7%	49.5%	50.4%
Contribution to investment	17.6%	25.3%	33.5%	-1.3%	42.8%	32.9%	40.7%	64.8%	133.2%	169.2%
Rate of Return	6.5%	7.7%	8.9%	6.4%	8.0%	8.5%	8.4%	8.0%	8.0%	8.0%
Debt Service ratio	8.0	2.8	2.0	1.0	1.8	1.8	1.8	1.4	2.1	2.2
Debt on Debt plus Equity	27%	46%	50%	41%	38%	36%	35%	30%	27%	23%
1984 CONSTANT PRICE ANALYSIS:										
Treated Water Tariffs [W/Ton]	169.1	175.0	193.8	183.8	204.6	194.5	198.8	194.9	185.6	174.1
Salary 000/employee/year	3.5	4.0	3.9	4.1	4.2	4.3	4.4	4.6	4.7	4.8
Operational Cost Million Won		14085	15385	16334	16880	17432	18327	19143	20191	21046
Operational Cost per Ton Sold	212.8	148.9	138.8	135.3	128.4	120.7	115.1	109.8	107.0	103.6
Incremental Operat. Cost/Ton Sold							60.5	57.1	82.2	61.8

CRITICAL FINANCIAL INDICATORS FOR THE PERIOD 1985-1991:

VARIABLE OR INDICATOR	MINIMUM	MAXIMUM	AVERAGE	VARIABLE OR INDICATOR	MINIMUM	MAXIMUM	AVERAGE
Cash	424	27484	7548	Debt Service Ratio	1.0	2.2	1.7
Water Tariff, constant prices	174.1	204.6	192.0	Days Accounts Receivable	6	7	6
Working ratio	48.7%	57.8%	51.8%	Debt/[debt + equity]	23.0%	40.7%	33.3%
Rate of Return	8.4%	8.5%	7.8%				

12-Jul-85

ANNEX 11

KOREA

NAMGANG AND TAEGU WATER SUPPLY PROJECT

Economic Analysis

Least Cost Solution

1. The water demand and the selection of the treated water system for the NRS was an issue during the project preparation (paras. 2.04 and 6.04). The treated water system selected is more efficient and economic than the raw water systems built previously. In addition to the proposed solution the least cost analysis studied three other alternatives, including the construction of a new dam at Daeryong, (which has a 50% higher present value than the proposed system), underground water (which was not satisfactory in quantity and quality), and combinations of these two, with additional reservoirs. The alternative selected, (the use of water from the existing Namgang Reservoir) is the least cost solution at discount rates of 8% to 15%. The treatment plant and pumping facilities would be constructed in two stages. During the appraisal, several components were further scaled down and the cost of the NRS reduced some 12%. The Feasibility Study analyzed the design period for the pipelines and demonstrated that the most economic design was for the year 2001 (13 years after completion), given their small diameter (less than 1,100 mm), the long transmission distances and terrain difficulties.

2. The supply of water from the Nakdong river for Taegu City is also the least cost solution at any discount rate. This was concluded from the Feasibility Study for the First Water Supply Project, updated in 1984. Some of the facilities required for the proposed TWS were built under the First Project. After the project completion, Taegu would have a total capacity of 1,120,000 tpd from the Nakdong river and 140,000 tpd from other sources. The provision of additional water for Taegu after 1995 would require the construction of additional and expensive dams, like the proposed Daecheon Dam being planned by MOC.

Project Cost

3. Detailed analysis of the personnel, power and other expenditures for the NRS are presented in Annex 11A, Table 1. The assumptions used to forecast operational expenditures are explained in the footnotes to this table. The estimated expenditures are close to their economic cost and shadow prices are not considered necessary. The main cost of the NRS is the capital expenditures for the pipelines, since their design horizon, based on economic analysis is the year 2001.

4. The operational expenses of the TWS are easily estimated, since the first stage, of the same capacity as the proposed system, is under operation. Detailed projections of operational expenses (Annex 10, Table 1), indicate that there are considerable economies of scale in administration, accounting, personnel, etc. and the incremental cost of operation is estimated at W65 per ton, (Annex 10, Table 5.)

Incremental Financial Rate of Return

5. The Incremental Financial Rate of Return (IFRR) for the NRS based on existing tariffs for bulk, treated water (W 82.7 per ton, Annex 11A, Table 2), is only 2 %. This is the result of the present policy by ISWACO to apply the same water charges nation-wide to all cities irrespective of the cost in each locality. This results in apparent low rates of return for any project where the cost of water is above the average cost. This pricing policy is being studied by consultants (para. 1.08 (a)), and improvements could include the implementation of marginal pricing based on the local cost of water or water surcharges for those localities where the cost is well above the average, as in the NRS.

6. A better proxy for the benefits of the NRS is obtained by considering the total cost and tariffs when providing water to the consumers. This is presented in Annex 11, Table 2, which includes the capital and operating expenses of bulk water, and expenses incurred by the 13 municipalities to distribute the water and collect revenues. The basic assumptions are explained in the footnotes to this table. The additional investments for distribution works are estimated from the planned investment programs of the cities. The cost of house connections is not included, since this cost is fully charged to the users and balances out, but the contributions to investments ("connections fees", averaging W 60,000 for each new connection) are included. The quantifiable benefits include the sale of retail treated water, (which is the bulk water sold by ISWACO less the unaccounted-for water). This analysis also provides an apparent low rate of return of 6 %. Sensitivity analysis shows that the rate of return would be 5 % if the investment is increased 10% or the the benefits are reduced 10%, and would be 4% if the investment is increased 10% and the benefits are reduced 10%. This can be explained, since the benefits are based on the water tariffs of Chungmu and Samcheonpo, averaging W 230/ton in 1983, which do not cover the cost of operation of the present system. In fact it is surprising that the population in these cities is willing to pay such tariffs for water services so deficient in quantity, quality and reliability. Therefore the use of existing tariffs, which in any case is only a minimum indication of the willingness to pay, does not provide a meaningful evaluation of the project benefits.

7. However, water is the main hindrance to the development of this region, and the highest felt need of the population. In fact even in the two cities, less than 15% of the population can presently use flush toilets. Some of the benefits of water supply, not measured by the tariff revenues, can be estimated from the comparison of the value of houses with and without public water supply. In Samcheonpo, where the types and sizes of houses are similar, about 40% of the population live in areas without public water supply and rely on handpumps or wells. Water in these systems is of poor quality and its extraction, especially during the harsh, dry Korean winter, is difficult. Based on data from the Samcheonpo City and the consultants, the price of a low income house (15-20 pyongs) with public water supply is about W 20 million, and without water supply is

only W 16 million. It is difficult to assess the portions of the difference attributable to the availability of public water supply and to other factors, (like better location). A conservative estimate of the additional water benefits is obtained by including 20% of this difference in real estate values, or about W 0.8 million per new house benefitting from the project. Using this indication of the additional benefits resulting from water supply the rate of return for the NRS is 13%, which is a better proxy for economic rate of return of this component (Annex 11A, Table 3).

8. The IFRR for TWS is estimated at 18% based on existing tariffs and the small increase (5% in real terms) required to comply with the financial covenant after 1985. Since water tariffs are well above the marginal cost this rate of return is taken as a proxy for the economic rate of return of the TWS (Annex 11B). Sensitivity analysis indicate that this ERR would be reduced to 17% if the investment is increased by 10%, and would be 16% if the benefits are reduced 10%. Even if the investment is increased 10% and the benefits reduced 10% the IFRR would still be 15% (Annex 11B). The additional benefits by comparison of the price of a house with and without public water supply are not applicable, since a house in areas without piped water in Taegu (which would soon reach 98% connected) is not saleable as a house but just for the value of the land.

Marginal Cost

9. The marginal cost for the NRS is estimated at W 174 per ton (US$0.20 per ton), Annex 11 A, Table 2. This indicates that the economic cost of the water in this system at a 10% discount rate is twice the present national tariff for treated water, and that the proposed tariff study should analyze and make recommendations on this problem.

10. The marginal cost for TWS at 10% discount rate is W148 per ton. Present tariffs for treated water were W200 per ton in 1984, 35% higher than the marginal cost. This is due to TWB financial requirements, in particular to the present practice of financing by internal cash generation and short term bonds about 60% of the water investments (para. 1.08 (a)). After the main water investments are completed, this high level of tariffs may be useful to contribute to priority sewerage investments, if both services are integrated in the future.

KOREA - NAMGANG AND TAEGU WATER SUPPLY PROJECT

ECONOMIC ANALYSIS NAMGANG REGIONAL SYSTEM - ANNUAL OPERATIONAL EXPENSES 1]

(Million Won - Prices of June 1985)

Year	AVERAGE WATER DEMAND (Million Tons/Year)		Number of Employees 2]	Personnel Expenses 3]	Power Demand Charges 4]	——POWER USER CHARGES——			Chemicals 6]	Material and Maintenance 7]	Others 8]	Water Rights 9]	Total Expenses	Total Expenses per ton Produced
	Chungmu System	Samcheonpo System				Raw Water 5]	Chungmu System 5]	Samcheonpo System 5]						
1988	10.69	2.88	30	137.7	82.8	104.5	195.7	21.3	40.7	107.7	27.5	20.4	738.4	54.4
1989	11.54	3.55	30	137.7	82.8	116.2	231.8	26.2	45.3	107.7	27.5	22.6	797.7	52.9
1990	12.45	4.27	30	137.7	82.8	128.7	249.8	31.6	50.1	107.7	27.5	25.1	841.0	50.3
1991	13.44	5.05	30	137.7	82.8	142.4	269.8	37.4	55.5	107.7	27.5	27.7	888.6	48.0
1992	14.15	5.60	30	137.7	137.6	152.1	284.1	41.5	59.3	114.0	27.5	29.6	983.4	49.8
1993	14.90	6.19	30	137.7	137.6	162.3	299.0	45.8	63.3	120.7	27.5	31.8	1025.5	48.6
1994	15.57	6.80	30	137.7	137.6	172.2	312.5	50.3	67.1	127.8	27.5	33.6	1066.3	47.7
1995	15.70	7.45	30	137.7	137.6	176.2	315.0	55.1	69.4	135.2	27.5	34.7	1090.5	47.1
1996	17.35	8.13	30	137.7	137.6	196.2	348.2	60.1	76.4	143.2	27.5	38.2	1165.2	45.7
1997	18.09	8.89	30	137.7	137.6	206.2	363.1	64.3	80.3	150.9	27.5	40.2	1207.9	45.1
1998	18.86	9.27	30	137.7	137.6	216.8	378.6	68.6	84.4	158.0	27.5	42.2	1252.3	44.5
1999	19.67	9.88	30	137.7	137.6	227.5	394.7	73.1	88.6	167.6	27.5	44.3	1298.7	44.0
2000	20.50	10.51	30	137.7	137.6	238.8	411.4	77.8	93.0	176.6	27.5	46.5	1347.1	43.4
2001	21.37	11.18	30	137.7	137.6	250.6	428.8	82.7	97.6	186.1	27.5	48.8	1397.5	42.9

1] Source: Woobo and Renardet Feasibility Study and Appraisal estimates.
2] 20 persons in the Water Treatment Plant, 8 in the water intake and 2 in the reservoir.
3] Monthly salaries for the 14 technical staff average W367,000, and W200,000 for non-technical staff. Total annual payment is 18 salaries, averaging W382,600 per person per month.
4] Demand charges of W2953/KW/month. Chungmu 1237 Kw up to 1991 and 2062 Kw thereafter. Samcheonpo 320 Kw up to 1991 and 520 Kw thereafter. Intake pump 760 Kw up to 1991 and 1300 Kw thereafter.
5] Power charges of W44.05 per Kwh. Power Factor 0.7. Samcheonpo 8.5 Kw/Ton, average head 50m (about 0.197 kwh/ton), Chungmu 18.2 Kw/Ton, average head 107m (about .416 KWh/ton).
6] Chemicals are estimated at W 3 per mt.
7] Estimated as a percentage of the value of each system, increasing with age from 0.4% to 0.65.%. (ISWACO 1982-84 average was 0.55 %.
8] Other expenses, including a share of central administration estimated at 20% of personnel expenses. for treatment plants.
9] Estimated compensation cost to KEPCO of W 1.5/ton for partial lost of power generation (total production 12,600 KW maximum production of 38 million KWH per year.

25-May-85

KOREA - NAMGANG AND TAEGU WATER SUPPLY PROJECT

INCREMENTAL FINANCIAL RATE OF RETURN (IFRR) FOR NAMGANG SYSTEM BASED ON BULK WATER TARIFFS

(Million Won - Prices of June 1985)

YEAR	PROJECT EXPENDITURES: PROJECT INVESTMENT 1]	PROJECT EXPENDITURES: OPERATIONAL COSTS	PROJECT EXPENDITURES: TOTAL COST	PROJECT BENEFITS: BULK WATER SOLD MILL.TONS 2]	PROJECT BENEFITS: WATER TARIFF WON/TON 3]	PROJECT BENEFITS: WATER REVENUES	PROJECT BENEFITS: NET FINANCIAL BENEFITS
1985	131		131				-131
1986	11229		11229				-11229
1987	11407		11407				-11407
1988	4151	738	4890	13.6	82.7	1123	-3767
1989		798	798	15.1	82.7	1248	450
1990		841	841	16.7	82.7	1382	541
1991		889	889	18.5	82.7	1530	641
1992	1600	983	2583	19.8	82.7	1634	-949
1993	1200	1026	2226	21.1	82.7	1744	-482
1994		1066	1066	22.4	82.7	1850	784
1995		1091	1091	23.1	82.7	1914	823
1996		1165	1165	25.5	82.7	2107	942
1997		1208	1208	26.8	82.7	2215	1007
1998		1252	1252	28.1	82.7	2327	1074
1999		1299	1299	29.5	82.7	2443	1145
2000		1347	1347	31.0	82.7	2565	1218
2001-2023		1398	1398	32.5	82.7	2691	1294
Present Value at 0% Discount:							16882.2

THE INCREMENTAL FINANCIAL RATE OF RETURN (IFRR) IS: 1.5%

IRR SENSITIVITY ANALYSIS:

	IFRR
Benefits reduced by 10%	0.3%
Investment cost increased 10%	1.0%
Cost +10%, water sold -10%	-0.2%

MARGINAL COST ANALYSIS FOR BULK WATER

Discount rate	PRESENT VALUES OF: Investment Mill. W	Total Expenses Mill. W	% Investment on Total	Volume Sold Mill. Tons	MARGINAL COST: Investment W/Ton	Total W/Ton
5%	25436	42345	60%	375	67.8	112.9
8%	23320	33828	69%	229	101.6	147.4
10%	22060	30035	73%	172	127.8	174.1

1] In June 1985 prices, including physical contingencies, but excluding taxes.
2] From Annexes 3 A and 10 A (Table 1).
3] The average tariff for treated water in 1985 is W 81.1 per Ton of water. To comply with the financial covenant in 1986 this tariff would be increased to W 85.8 per Ton, or W 82.7 in 1985 prices.

25-May-85

KOREA - NAMGANG AND TAEGU WATER SUPPLY PROJECT

ECONOMIC RATE OF RETURN (ERR) OF THE NAMGANG SYSTEM BASED ON RETAIL WATER TARIFFS

(Million Won - Prices of June 1985)

YEAR	TOTAL COSTS: BULK WATER — NET PROJECT INVESTMENT 1]	TOTAL COSTS: BULK WATER — OPERATIONAL COSTS 2]	TOTAL COSTS: DISTRIBUTION SYSTEM — NETWORKS AND STORAGE 3]	TOTAL COSTS: DISTRIBUTION SYSTEM — INCREMENTAL OPERATION & ADMINISTRATION 4]	TOTAL COSTS: DISTRIBUTION SYSTEM — TOTAL COST MILLION W	DIRECT BENEFITS: NEW POPULATION SERVED 1000 5]	DIRECT BENEFITS: NEW HOUSES OR APPARTMENTS WITH WATER 1000 5]	DIRECT BENEFITS: RETAIL WATER SOLD MILLION TON 6]	DIRECT BENEFITS: WATER REVENUES MILL. W 7]	DIRECT BENEFITS: CONNECTION FEES MILL. W	DIRECT BENEFITS: NET DIRECT BENEFITS MILL. W	DIRECT BENEFITS: BENEFITS MEASURED BY REAL ESTATE VALUES 8]	NET BENEFITS INCLUDING REAL ESTATE VALUES MILL. W
1986	131	0	1650		1781						-1781		-1781
1988	11229	0	3631		14860						-14860		-14860
1987	11407	0	3631		15038						-15038		-15038
1988	4131	738		288	5178	77.0	14.8	7.20	1789	888	-2500	11848	9348
1989	0	788	150	412	1360	90.8	17.5	10.30	2559	159	1358	2123	3481
1990	0	841	150	463	1454	105.6	20.3	11.57	2873	171	1590	2277	3867
1991	0	889	150	519	1558	121.5	23.4	12.88	3224	183	1850	2446	4296
1992	1600	883	150	557	3291	131.5	25.3	13.84	3462	115	286	1538	1825
1993	1200	1026	150	598	2973	141.8	27.3	14.85	3713	119	859	1585	2443
1994	0	1066	150	638	1854	152.5	29.3	15.84	3960	123	2229	1646	3875
1995	0	1091	150	859	1900	163.7	31.5	16.49	4095	129	2324	1723	4048
1996	0	1185	150	734	2049	175.2	33.7	18.34	4557	133	2640	1769	4410
1997	0	1208	150	771	2129	186.0	35.8	19.28	4790	126	2785	1662	4447
1998	0	1252	150	810	2213	197.1	37.9	20.26	5032	128	2947	1708	4655
1999	0	1299	150	851	2300	208.7	40.1	21.27	5284	134	3119	1785	4903
2000	0	1347		893	2240	220.8	42.4	22.33	5547	137	3444	1831	5275
2001-2023	0	1398		937	2335	232.9	44.8	23.43	5820		3485		3485

ECONOMIC RATE OF RETURN (ERR) AND SENSITIVITY ANALYSIS:

	INCLUDING DIRECT BENEFITS ONLY	INCLUDING BENEFITS INDICATED BY REAL ESTATE VALUES:
Economic Rate of Return, basic case:	6.1%	12.5%
If Investment is increased 10%	5.4%	11.0%
If benefits are reduced 10%	4.8%	10.3%
If benefits are reduced 10%, and the investment increased 10%	4.2%	9.0%

1] From Table 2, total investments to produce bulk treated water.
2] From Table 2, total operational expenses for bulk, treated water.
3] Investments by Chungau (W 6,084 million), and Seacheonpo (W 1,286 million) between 1986-87. These two cities would use 78% of the project capacity. Per capita network investments in the other municipalities would be smaller and cheaper. Nertheless the network investments in Chungau and Seacheonpo were increased 20% because of this reason. Investments in tertiary distribution or house connections are not included, since they are whole financed by house connections charges.
4] Based on present expenses in the project municipalities (especially Chungau and Seacheonpo), for personnel, maitenance and administration, and excluding treatment costs. After the project some areas would be served by gravity. Incremental wages and administration are estimated at W 20 per mt, excluding the share for treatment plants and considering economies of scale. Materials and maintenance are estimated at W15 per mt. The total estimated cost is W40 per mt.
5] The number of new houses or appertments is based in the incremental population served (Annex 3B, Table 6), divided by 5.2 persons per house. There are 4.5 persons per household.
6] Bulk water sold by ISWACO less the unaccounted-for water.
7] Average (W230 per mt) of the 1983 tariffs in Chungau and Seacheonpo, the main consumers in the project. Increased 8% to express it in 1985 prices. Under ADB's financed project financial covenants would raise theses tariffs in constant prices some 10%.
8] Many houses in Seacheonpo and Chungau do not have connections to the present water system, since there is no distribution in several neighborhoods. Comparable, low income houses of 20 pyongs are valued at W 18 millions without public water and W 20 million with piped water. However this differences may also include other factors, like the better location of neighborhoods with water. A conservative estimate of the water benefits indicated by this values is taken as 20% of the difference in real estate values, or W800,000 per household, equivalent to 4% of the price of a low income house. These benefits are assumed only when each house is actually connected, but the increase in the value of the house is likely to occur when distribution networks are available in the neighborhood.

25-May-86

Annex 11B

NAMGANG AND TAEGU WATER SUPPLY PROJECT

ECONOMIC RATE OF RETURN [ERR] FOR TAEGU BASED ON EXISTING WATER TARIFFS

(Million Won - Prices of June 1985)

YEAR	PROJECT EXPENDITURES: PROJECT INVESTMENT 1]	OTHER INVESTMENT 2]	OPERATIONAL COSTS 3]	TOTAL COST	PROJECT BENEFITS: WATER SOLD MILL.TON 4]	WATER TARIFF W/TON 5]	WATER REVENUES	OTHER REVENUES 6]	NET BENEFITS
1985	2160	1710		3870		208.0			-3870
1986	15521	962		16483		216.3			-16483
1987	15222	911		16133		216.3			-16133
1988	11603	864	480	12948	7.4	216.3	1598		-11349
1989		819	1468	2287	22.6	216.3	4886	1082	3681
1990		800	2402	3202	37.0	216.3	7992	1081	5872
1991		800	3333	4133	51.3	216.3	11090	1110	8067
1992		800	4035	4835	62.1	216.3	13428	1210	9802
1993		800	4747	5547	72.9	216.3	15773	1278	11504
1994		800	6840	7840	85.5	216.3	18494	1350	12203
1995		800	7804	8604	97.6	216.3	21100	1386	13882
1996			8800	8800	110.0	216.3	23793	1406	16399
1997			9224	9224	115.3	216.3	24939	1327	17042
1998			9224	9224	115.3	216.3	24939	0	15715
1999			9224	9224	115.3	216.3	24939	0	15715
2000			9224	9224	115.3	216.3	24939	0	15715
2001-2023			9224	9224	115.3	216.3	24939	0	15715
Present Value at 0%	44506	10088	335077	389649	4236	9507	916214	11230	537795

The Economic Rate of Return [ERR] is 17.8%

SENSITIVITY ANALYSIS:

	ERR
Benefits reduced by 10%	15.8%
Investment cost increased 10%	16.8%
Investment +10%, Water Sales -10%	15.0%

MARGINAL COST ANALYSIS

Discount Rate	PRESENT VALUES OF: Investment Mill. W	Total Expenses Mill. W	% Investment on Total	Volume Sold Mill.Ton	MARGINAL COST: Investment W/Ton	Total W/Ton
5%	46652	147022	32%	1288	36.2	114.2
8%	42759	102190	42%	770	55.5	132.7
10%	40448	83975	48%	568	71.3	147.8

1] In 1985 prices, including physical contingencies, but excluding taxes.

2] Complementary distribution and leak detection works (Annex 8, Table 2). The cost of house connections is fully paid by users charges (developer's contributions), and does not affect the economic analysis.

3] Since there are economies of scale in several operational expenses, the incremental cost is estimated at W 85 per ton sold until 1993 (Annex 9, Table 5) and W 80 per ton thereafter.

4] Details in Annex 3 B.

5] The water sold include 45,000 tpd of semi-treated water sold to tehe textile industrial zone at a lower rate of W 175 per ton. The remaining water, and in particular the water produced by the project would be fully treated, and is sold at and average price of W 200 per ton in 1984 prices or W208 in 1985 prices. After the 5% real tariff increase in 1986 (required to comply with the rate of return covenant, the tariff is kept constant.

6] Include user's contributions and about 10% of the other operating revenues

11-May-85

ANNEX 12

KOREA

NAMGANG AND TAEGU WATER SUPPLY PROJECT

Assumptions for Financial Projections

Inflation

1. Project cost tables assume that foreign price increases would be 5% p.a. in 1985, 7.5% p.a in 1986, and 8% in 1987-88. Local inflation in 1983 and 1984 has been only about 3%. Government efforts to curtail inflation are likely to hold inflation below these levels, in which case exchange adjustments may be used on the average, to maintain the "purchasing power parity" with international prices. The financial projections assume that the local inflation would be about 2.5% in 1985, 5% in 1986 and and 5.5% thereafter. The exchange rate for 1985 is assumed at W 850 per US dollar.

Financial Projections

2. The project cost, demand and financial projections use computer programs developed by the appraisal team using Lotus 1-2-3. Only the main financial statements (Table 1 - Income, Table 2 -Flow of Funds, Table 3 - Balance, Table 4 - Financial Plan and Table 5 - Monitoring Indicators) are included in Annexes 7, 8 and 10 for ISWACO's Water and Dams' Divisions and Taegu Water Bureau, respectively. Additional tables, available in the project file, provide details of all the assumptions and intermediate results regarding demand, fixed assets and revaluation, debt service, operational expenses, tariffs and revenues, etc. Therefore only the main assumptions are explained below. The financial projections were discussed with ISWACO and the Taegu Water Bureau, and reviewed during negotiations.

ISWACO's Water and Dams Divisions

3. Assets Revaluation. Korean regulations allow for the revaluation of fixed assets when their estimated value exceeds the book value by 25% or more. Under the Second Water Supply Project, ISWACO's Water and Dams assets had to be revalued before December 31, 1984. This was done for the Dams' Division in December 1983, doubling the book value for this Division. However for the Water Division, where revaluation is not expected to exceed 20% (because the assets are relatively new and inflation has been low), the assets revaluation is expected to be completed only in 1985. The fixed assets of Taegu's Water Bureau were revalued at the end of 1984 and incorporated in the books as of January 1, 1985. After 1985, the appraisal financial projections assume a revaluation of fixed assets, using 85% of the wholesale price index increases as a proxy for the increased value. For Chungju Dam, which would be in partial operation by June 1985, power generation is expected to be less than half the installed capacity. Land acquisition and some smaller complementary would be completed in 1986. Therefore about 70% of the Chungju Dam fixed assets are assumed to enter into operation in 1985, with the remaining entering in 1986.

4. Taxes. ISWACO pays income and defense taxes at a rate of about 17% of its net income before taxes. Taxes are levied on the total operations of ISWACO, and there are allowances for accelerated depreciation and for deduction of interest (operational and capitalized). Therefore is very difficult to estimate the taxes in advance, and even more to allocate them to each of ISWACO's Divisions. This would made difficult and controversial the calculation of the tariffs required to comply with the rate of return covenant, and therefore taxes, which are less than 12% of the net income, have been excluded from the rate of return calculation.

5. Water Division. The Water Division owns and operates nine regional systems providing water in bulk to cities or industrial areas. These facilities are generally constructed by MOC and transferred to ISWACO for operation and maintenance. Most of the water (95%) is provided raw (without treatment). Detailed water demand projections for the NRS are presented in Annex 3B. These projections are based on government plans for the region and were revised by the consultants during the final design. They assume that after water supply is assured, the population and development of the region, now lagging compared to other regions, would accelerate, and the two main cities would achieve population growth rates of up to 4% p.a. This is feasible because these coastal cities have a great potential for development, and new infrastructure is being built including tourist developments, industrial estates, and a new harbor. Road access to the area is also being improved.

6. The main expansion of ISWACO's bulk water supply systems would be the Metropolitan Region Water Supply Project, providing treated water to 25 municipalities in the Seoul Metropolitan Region (but excluding Seoul City). This water would be provided raw to three cities (Incheon, Bucheon and Gwangmyeong) which are building a joint treatment plant (partially financed by ADB). ISWACO would sell treated water (produced in another two treatment plants) to the remaining 22 municipalities. The water tariffs were raised by 10% in December 1984. The tariff includes fixed charges (for the volume of water contracted), variable charges with the volume of water used, and excessive consumption charges for water used above the contracted limit. The financial targets for national water tariffs and tariff

Table 1. ISWACO's Water Tariffs (December 1984)

	Raw Water	Treated Water
	Won/Ton	
Fixed Charges for the Water Contracted	18.7	61.6
Variable Charges for the Water Used	14.3	8.8
Excessive Charges for Consumption above the Contracted Supply	60.5	77.0

policies and rationale would be reviewed under a tariff study (SAR para. 1.08(b)), to be completed by September 30, 1986 (terms of reference are available in the Project File). Since the water charges for excessive consumption are more than four times those for the water used, the average rate fluctuates and may actually be lower when the volume contracted increases (e.g., between 1983 and 1984).

7. Power expenses represent almost 60% of the total, include a fixed charges for the installed capacity, and charges per kwh used. These expenses are expected to increase roughly in proportion to the volume of water produced. Actual expenses would however decrease, because charges for installed capacity would remain constant, although a real increase in power rates of about 1% p.a. compensates for this factor. The number of staff also remains constant until the new projects enter into operation, and unit personnel expenses are expected to increase 2% to 3% per year in real terms, including the cost of retirement benefits. Details of the number of new employees required, materials and maintenance expenses projected on the basis of historical trends, and for increments due to the new projects are detailed in the annexes available in the Project File. Central administrative expenses are allocated in proportion to the staff in each division.

8. Debt service is mainly with ADB, which financed the First Metropolitan Project ($22.2 million, payable in 24 years at 7.5%), as well as the Gumi system ($4.2 million, payable in 20 years at 8.3%) and the Geum Gang System ($24.33 million). Bank loans for the Metropolitan Region Water Supply Project and for the proposed project would be paid by ISWACO with the same terms and conditions as the Bank loan, plus a 0.05% handling charge. The foreign exchange risk would be bourne by ISWACO. The remaining cost of the NRS would be financed by equity contributions. These are preferred by the Government instead of loans, given the need by ISWACO to internally generate funds for its large investments in dams until 1988 (para. 13). The Water Division is expected to transfer about W60 billion ($71 million) to the Dams' Division during this period. After these projects are completed, ISWACO would be able to assume a large internal generation and debt service for future water and dams projects.

9. Geumgang System. Under the new Public Enterprise Law, ISWACO is making an effort to increase its management efficiency and profitability. However, ISWACO has been forced to take over the operation of a bulk treated water system built by MOC (Geumgang). The direct operational expenses of this system per ton sold are more than three times the national water tariff charged by ISWACO due mainly to gross overestimation of demand. In anticipation of this possibility, it was recommended, under the Metropolitan Region Water Supply Project, that the financial problems created for ISWACO by this system should be treated as a special case since the capacity of this system is likely to remain largely underutilized for many years. For purposes of the rate of return covenant the full operational costs and depreciation of the system are included, but the fixed assets are excluded from the rate base until 1989 (inclusive). Although the capacity of this system is only 7% of the water production capacity of ISWACO, its fixed assets (about $90 million) are almost 40% of the

revalued fixed assets of this Division.

10. Dams Division. The Dams Division includes the total operation of the dams, the costs of which are allocated to three main purposes: (a) water rights (water for municipal and industrial use taken from ISWACO- regulated rivers); (b) power generated by ISWACO and sold in bulk to KEPCO; and (c) water used from ISWACO regulated rivers for irrigation. When each dam is completed, a detailed economic analysis is made to distribute its cost to the beneficiaries (water rights, power, irrigation, flood control, traffic or roads, land reclamation, etc.). The total cost is then allocated to each component, using the lower of the benefits or the alternative cost for each component. The cost allocation for flood control and 70% of the cost allocation for irrigation are financed by government grants, and are not included in ISWACO's fixed assets. In practice, ISWACO has not been able to collect revenues from the farmers (since the Ministry of Agriculture wants to subsidize food production), and the operational expenses for irrigation and flood control are now being charged to the other services.

11. Detailed demand projections for the sales of power, water rights, and irrigation water, from each dam under operation or construction and their respective charges and tariffs are presented in the detailed financial projections for this Division (available in the Project File). The Chungju Dam, financed by Loan 1666-KO, would start partial generation by mid-1985, and by 1986 would double the total power presently generated by ISWACO from its other three dams (Andong, Soyang and Daecheong). The power generated by ISWACO is cheaper to KEPCO than its oil, gas or nuclear generation. Therefore ISWACO's full power capacity is used as soon as it is available. However, since KEPCO presently has surplus generating capacity, it may try to curtail the purchase of power from ISWACO.

12. By 1988, the operating expenses other than depreciation would be less than 11% of the revenues of the Dams' Division. The remaining 89% of the revenues cover depreciation (33%), and the return on capital (56%), more than half of the revenues. About 52% of the operating expenses are for personnel. These expenses would almost double upon completion of the Chungju Dam. Additional provision for staff and other expenses is included upon completion of each of the other dams under construction: Hapcheon, the Nakdong Barrage, and Juam, by 1988, and Imha by 1989. Main power expenses are to pump back water at Andong during non-peak hours, to be used for generation during peak hours. Materials are forecasted based on the new assets entering into operation.

13. Flow of Funds The Dams Division would have investments of some $270 million in 1985, and a total investment of almost $1 billion during 1984-88 (Annex 8, Table 4). These investments are financed by several foreign loans (including Bank Loans 1666-KO and 2350-KO), three loans from OECF, several loans from the Korean Development Bank and the Korean Oil Fund and government contributions. These are summarized in Annex 8, Table 2 and further details on terms and conditions of these loans are presented in the detailed financial projections for this division (available in the Project File). These

investments, loans and contributions are provided in accordance with loans already signed or financial plans approved by the Government. Land reclaimed under the Nakdong Barrage would be sold between 1987 and 1989, and would largely improve the cash flow of this Division. MOC is doing feasibility studies for the construction of another five dams. However, no priorities or schedules have been approved, and detailed cost estimates are not available. ISWACO is now looking very critically at these new projects, requiring them to have a rate of return of at least 10% if they are to be financed by ISWACO. Tentative investments of W20 billion p.a., fully internally generated, have been included between 1989 and 1991 to provide for some of these projects.

14. Accounts receivable are about one month of the amount billed. Other fixed assets include those which are not included in the rate of return (para. 9). Accounts payable to contractors represent about month of the annual capital expenditures.

Taegu City Water Bureau

15. Assets Revaluation. TWB's fixed assets were revalued in accordance with the Korean law on January 1, 1985. For the financial projections, and to avoid apparent variations in the rate of return performance, this revaluation was applied from December 31, 1984. Assets are revalued thereafter using the same procedures as for ISWACO (para. 3).

16. Water Demand. Water production per capita increased 6.7% p.a. in Korea during the last 13 years. Even under rationed supply, the per capita consumption in Taegu increased 4.2% p.a. during the last seven years. The per capita income in Korea has been increasing at almost 6% per year, and this trend is assumed to continue in the future. Because of income elasticity of water and rapid industrial development the per capita water demand is likely to increase by about 3.5% p.a. for the next few years. However the consultants' (KECC) and the city's projections assume a much faster growth (5.5% p.a. between 1984-91), which is not considered realistic by the appraisal mission. Presently the consultants have reviewed and reduced their estimation

Table 2. Alternative Water Demand Estimates
(million tons/year)

Source	1985 Lpcd	1985 Water Sold	1988 Lpcd	1988 Water Sold	1991 Lpcd	1991 Water Sold	1996 Lpcd	1996 Water Sold
KECC (Original)	173	126.8	216	181.3	226	208.0	297	310.0
City	167	121.0	196	160.6	231	212.6	300	313.1
KECC (Revised April 13, 1985)	175	126.7	203	166.4	225	207.0	264	275.6
Appraisal	167	120.7	195	160.0	218	203.0	251	262.0

of the water demand. For the appraisal, the mission used the revised KECC estimates of per capita demand, but delayed by one year (the forecasted per capita consumption for a given year is applied to the following year). Table 2 gives details of the different demand projections

17. Operational Expenses. Detailed information on the projection of TWB's expenses and debt service is available in the Project File. This includes a detailed forecast of number of employees by category, power expenses, the cost of house connections (called construction consigned in Korea), and materials and maintenance expenses which represent almost 90% of the total expenses. The cost of house connections is fully paid by consumers. Although these expenses could be capitalized, included in the fixed assets and amortized, the Korean practice is to balance out the cost and revenues for this item in each year. This is simpler, but more conservative, and reduces the reported net income and rate of return.

18. The City is eager to start the construction of a treatment plant and transmission facilities to use water from the next water source (the Daecheon Dam), whose construction would be started by MOC. However, the appraisal demand estimates indicate that the Geumho Treatment Plant, which would use water from this dam, would not be needed until at least 1992 (although this treatment plant could reinforce the supply to the eastern part of the city, which is at the farthest distance away from the Nakdong river treatment plants). The financial projections show that unless the start of construction of this treatment plant is postponed until 1988, TWB would have significant cash deficits. Therefore agreement has been reached to postpone these works and scale down some of the other investments proposed by TWB.

19. Financing Plan. The overall financing plan (Annex 10, Table 4) includes the proposed Bank loan on standard conditions plus a 0.05% handling charge. Government loans would finance W9,440 million. These loans are provided through MOC's budget, and are repayable to KDB at 10% interest, with a 15 year term after 5 years grace. Disbursements in each year are considered a separate loan and amortized separately. Interest is not financed but paid at the end of each year.

20. Bonds are expected to finance W18,401 million, including interest accumulated until redemption. Bonds are compulsory and are linked to house sales, construction contracts, licenses, etc. This is based on the national policy established by MOHA and widely used by all cities to finance water works. These bonds bear interest rates of 6%, and capital and accumulated interest are paid after five years.

KOREA

NAMGANG AND TAEGU WATER SUPPLY PROJECT

Review of the Organization of the Water and Sewerage Services in Taegu City: Objectives and Scope of Work

Introduction

1. Taegu City presently operates its water services through an independently managed Water Bureau under a Director General reporting directly to the Vice Mayor and Mayor. The Water Bureau has separate budgets and maintains independent accounts of revenues and expenditures. It is fully responsible for its total operations, including management, finance, budgeting, accounting, planning, design, operations and maintenance.

2. The city's sewerage services are, on the other hand, the responsibility of a Sewerage Division within the Construction Bureau, under a Director reporting to the Director General of Construction. It is mainly responsible for the maintenance and expansion of the city's drainage systems consisting of street drains, main drains, natural water courses, drainage pumping stations, and flood protection works. It also has some responsibilities like river maintenance and flood relief works. It presently has no revenues of its own and is funded from the city's General Accounts, for both recurrent and capital expenditures within the annual allocations available to the Construction Bureau. However, the city will start levying sewer tariffs from July 1985 which are expected to finance operations and maintenance as well as a portion of the sewerage works as recommended in the Master Plan for Sewerage (1985-2001), completed in 1984. The city is already implementing the initial works under the Master Plan, and the Dalseocheon Treatment Plant would be completed and start operations in 1987. Other investments are being actively planned for the next few years.

3. As a result of the above improvements the Sewerage Division would have to be reorganized soon to take care of the following activities: revenue collection, accounts, budgeting its own revenues starting in July 1985, etc., and starting in 1987, to operate and maintain the Dalseocheon Treatment Plant and the new sewer interceptors. Additional staff is likely to be needed as well as changes in the existing organization. However, no study has been made to identify and assess these needs and the feasibility of making changes.

4. Major cities in countries all over the world have found that is more efficient and economic to organize their water and sewerage services under a unified management. This applies to cities where water and sewerage services are managed by public corporations as well as those where these services are part of the city's bureaus. In Korea, the Seoul Metropolitan Government has already successfully implemented the integrated management of its water and sewerage services under a Director General of one Water and Sewerage Bureau and is undertaking an extremely large investment program in both water and

sewerage facilities.

5. The integrated management of these closely related services includes the following advantages: better use of staff since accounting, revenue collection, public relations, etc. can be handled by the same staff; integrated planning of the expansion of both water and sewerage services; and coordination of construction planning for laying of water and sewerage pipelines, etc., to avoid unnecessary disruptions on roads and problems due to lack of the other service. An additional and even more important benefit is that the common management of these two services would result in the best use of financial resource for the planned expansion of both services. At any given time, while priority problems for one of the services may have been solved, and this service may have surplus cash or be investing in lower priority works, high priority works for the other service cannot be undertaken because of lack of funds. On the other hand, arguments can also be made for a separate and independently managed Sewerage Bureau, which could give its full attention to this service, but with a mechanism for close coordination of its planning and investments with the Water Bureau.

6. In the above context and in view of the significant expansions of both water and sewerage services under the city's Master Plans, it is important to review the organization of the water and sewerage services of Taegu City. The review would analyze all relevant factors specific to Taegu City and make proposals to improve the organization, coordination and staffing of water and sewerage services.

Objectives of the Review

7. The main objective is to analyze the present organization of the water and sewerage services in Taegu City and make recommendations for the institutional improvements which may be needed for the management of these two closely related services to:

(a) promote the optimal integrated planning and investments and ensure their complementary development;

(b) promote the design of efficient tariffs and more efficient use of the staff by sharing the accounting, billing and collection of revenues;

(c) promote the efficient utilization of staff, equipment, and financial resources, for construction, operation and maintenance and;

(d) allow for the transfer of surplus resources between the two services and their optimal investment planning.

Scope of Work

8. The review would use specialists experienced in institutional development, local government organization, technical and financial management of public utilities and legal aspects to carry out the following tasks:

In Phase 1:

(a) Examine in detail the present organization structure and staffing for managing the Water Bureau and the Sewerage Division and the distribution in the future of the sewerage-related functions within the city organization;

(b) Review the advantages and disadvantages of the present organizational arrangements in relation to the ongoing and proposed expansions in both services over the next ten years;

(c) Review the advantages and disadvantages of alternate organizational arrangements, to promote efficiency as outlined in the objectives of this review, in particular the joint management of the water and sewerage-related services under a single Bureau; and

(d) Make a detailed analysis of the legal, administrative, financial, technical and other changes that would be necessary to implement each of the alternative organizational arrangements that are studied, and examine the practical implications of such changes.

In Phase 2:

(e) The review would propose an organizational structure that would be consistent with the above objectives and practical to implement, and propose implementation guidelines, in particular the required number and organization of staff.

Reporting Requirements

9. The review would be made by MOHA in cooperation with the City Administration and the Directors General of the relevant bureaus. The initial part of the review, estimated to last about 6 months, and encompassing work detailed in paras. 8 (a) - (d) above, would produce a preliminary report including the analysis of the advantages and disadvantages of each alternative and the best option or options identified. After consideration by the City and relevant Government Ministries and a decision as to the preferred alternative, the Phase 2 of the review would study the implementation requirements for the preferred option as envisaged in para. 8 (e) above. This second phase would take about three months and would provide a report including final recommendations, implementing guidelines and any other relevant material.

ANNEX 14

KOREA

NAMGANG AND TAEGU WATER SUPPLY PROJECT

Documents Available in the Project File

1. Mission Working Papers

(a) Original and revised water demand.
(b) Financial projections for ISWACO's Water Division.
(c) Financial projections for ISWACO's Dams Division.
(d) Economic and social analysis.

2. Studies and other documents

(a) KECC and Nihon Suido. Master Plan and Feasibility Study for Taegu Water Supply Project (1981).

(b) KECC and Original Engineering Consultants. Taegu Water Supply Project 4th Stage Extension Feasibility Study (October 1984).

(c) Renardet Engineering, Woo Bo Engineering Inc. and Jung Woo Engineering Co., Ltd. Nam River Water Supply Project Master Plan and Feasibility Study (August 1983).

(d) Woo Bo Engineering Inc., Renardet Engineering and Jung Woo Engineering Co., Ltd. Nam River Water Supply Project Interim Design Report (September 1984).

(e) ISWACO's Water Management Annual Report (1983).

(f) Ministry of Home Affairs. Municipal Yearbooks 1983 and 1984.

(g) Ministry of Home Affairs. Financial Yearbook of Local Government (1983).

(h) The Bank of Korea. Financial Statement Analysis of Korean Companies (1983).

(i) KECC. Distribution Pipenet Analysis, Taegu City (March 1984).

(j) KECC. Taegu Water Supply Project: Basic Design Report (June 1984).

CHART 1

KOREA
NAMGANG AND TAEGU WATER SUPPLY PROJECT
Ministries and Main Functions in the Water Supply and Sanitation Sector

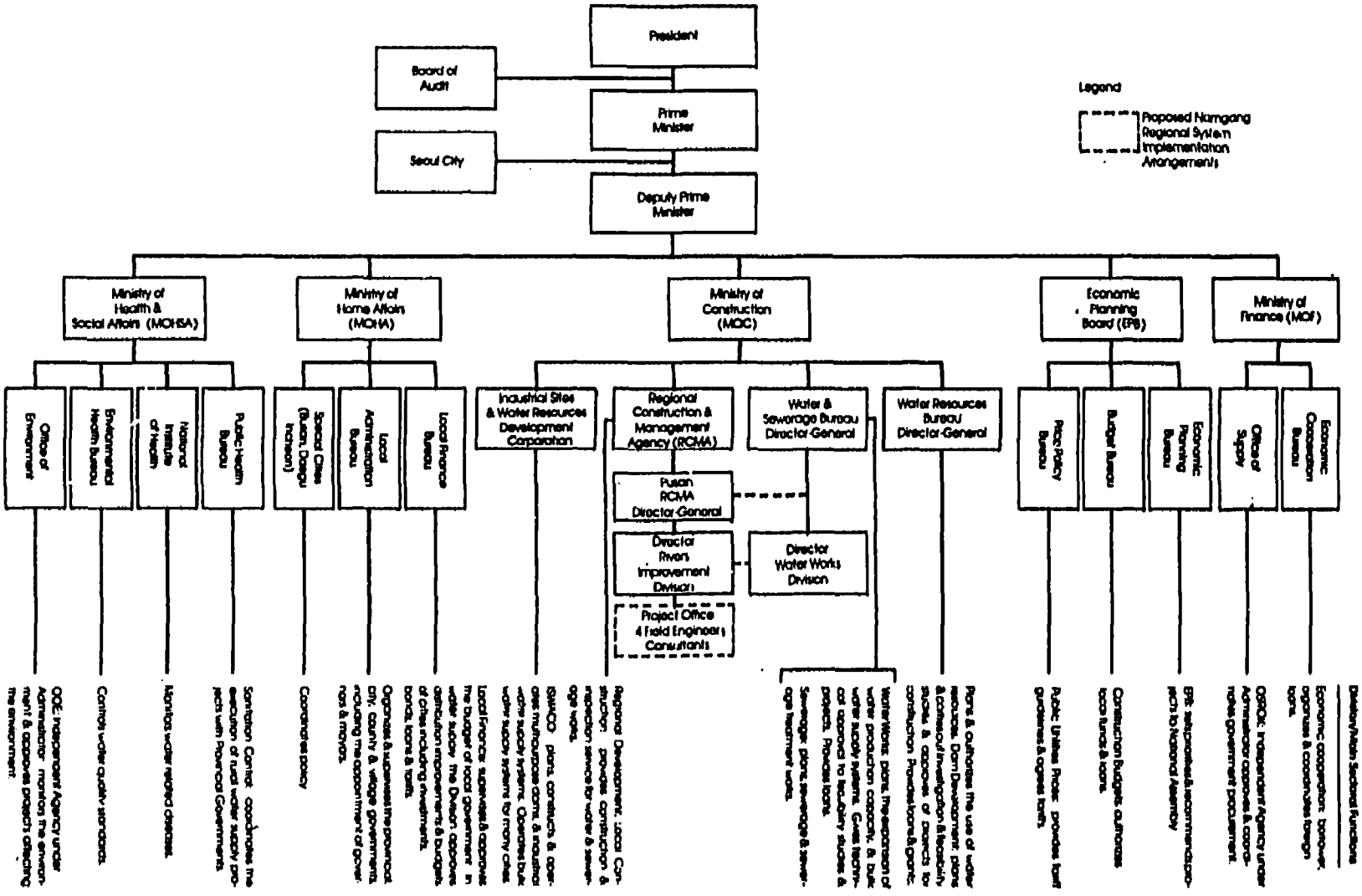
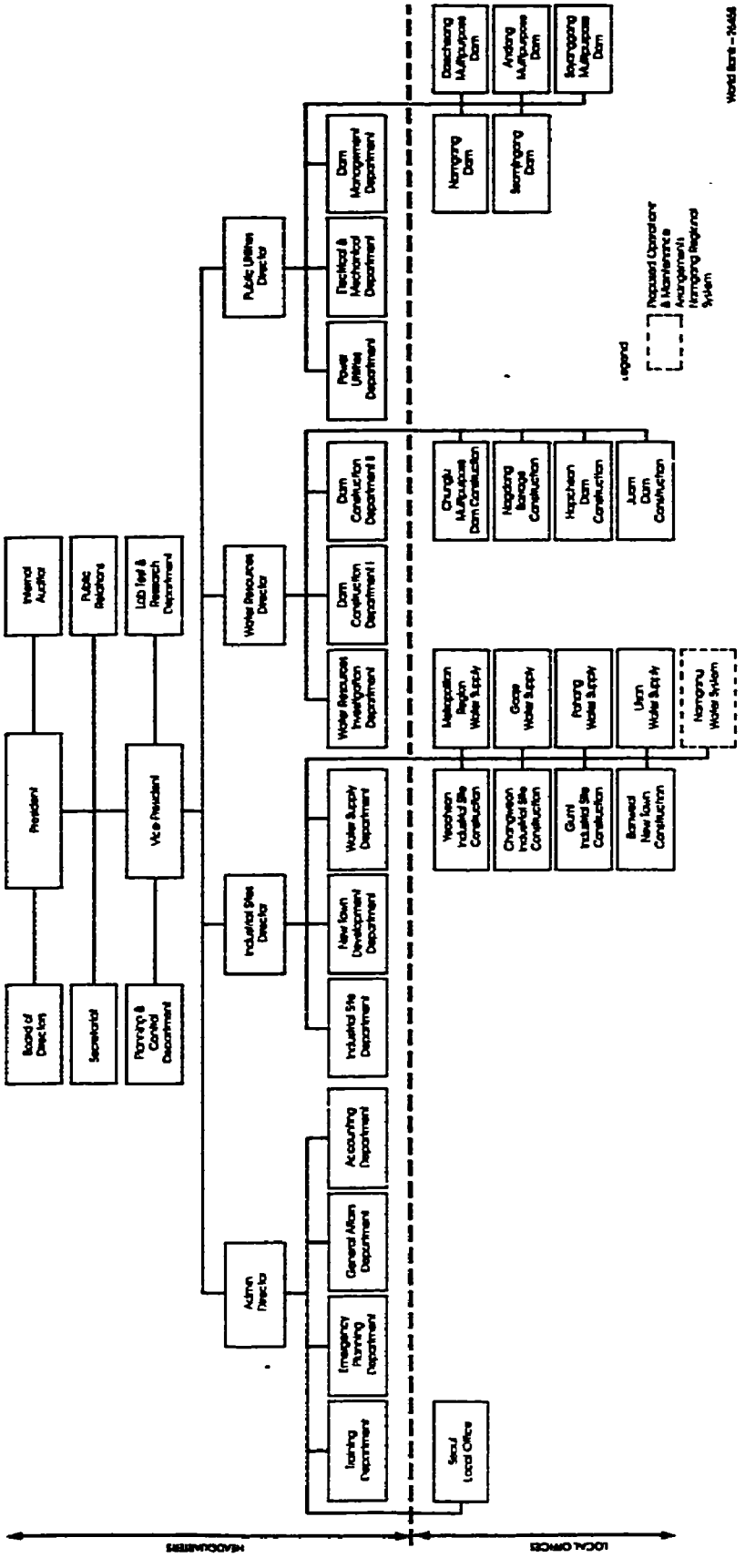
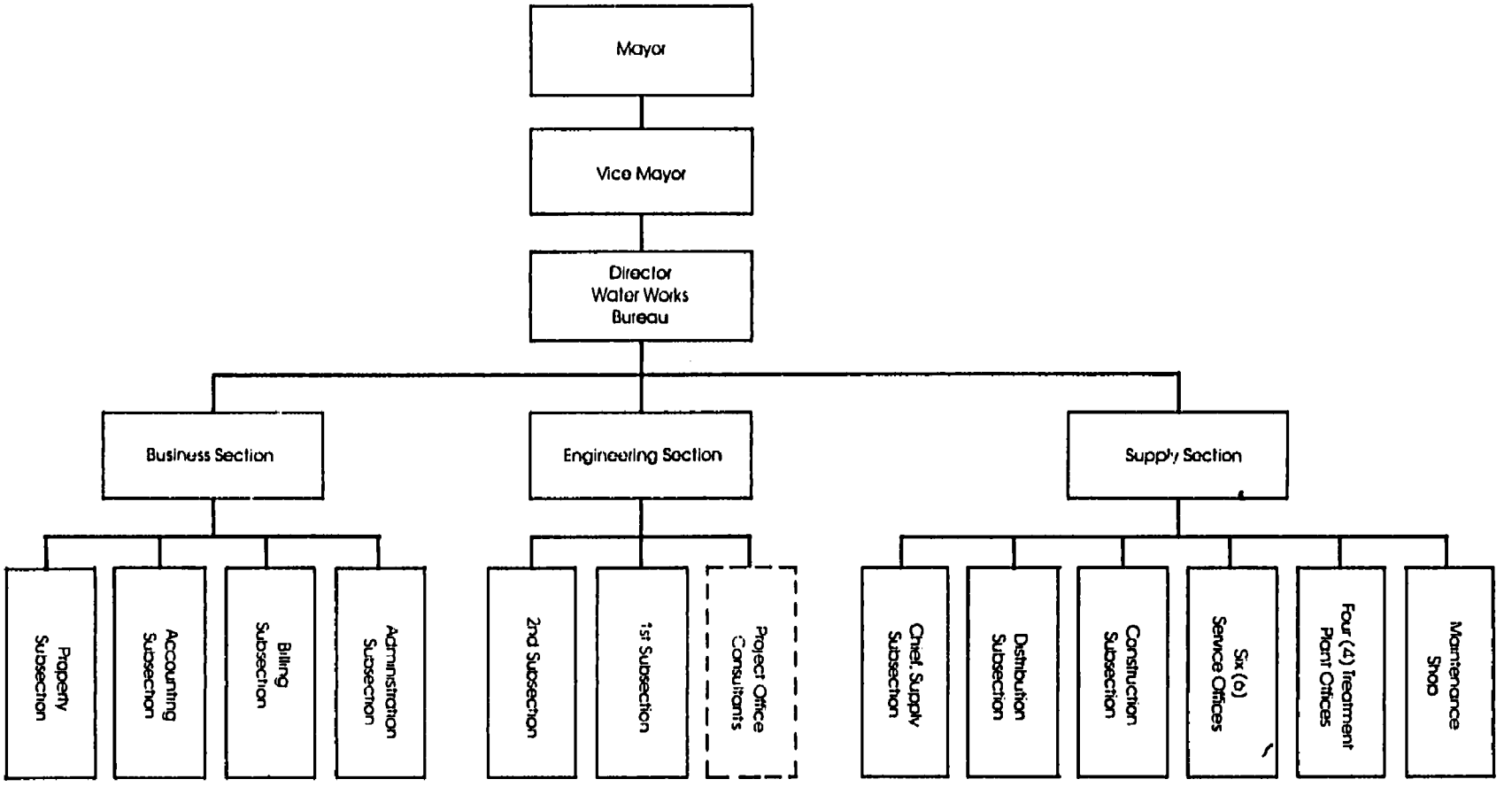


CHART 2

KOREA
NAMGANG AND TAEGU WATER SUPPLY PROJECT
ISWACO's Organization Chart



KOREA
NAMGANG AND TAEGU WATER SUPPLY PROJECT
Taegu Water Works Bureau Organization Chart and Implementation Arrangements



World Bank – 27414

CHART 3

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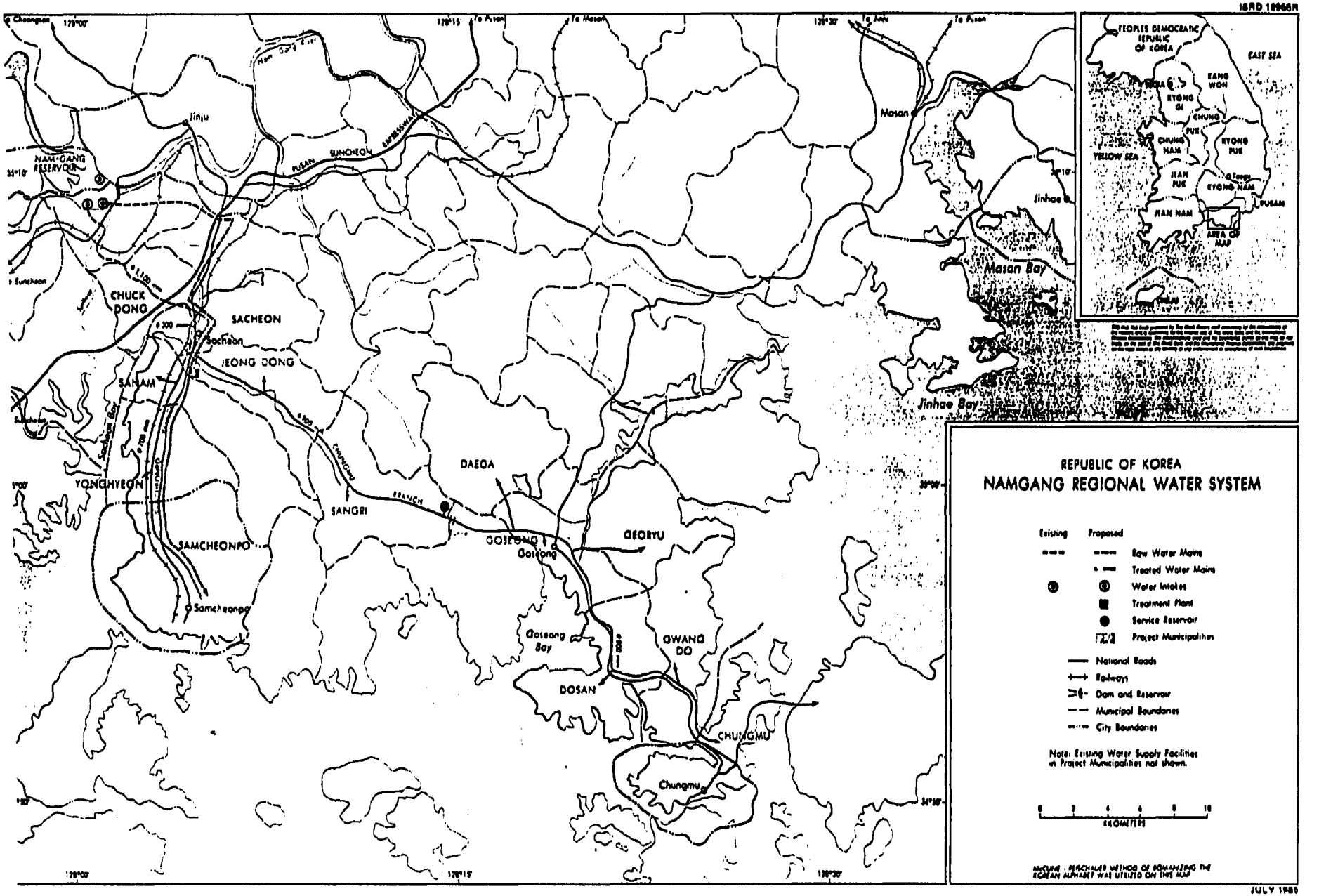
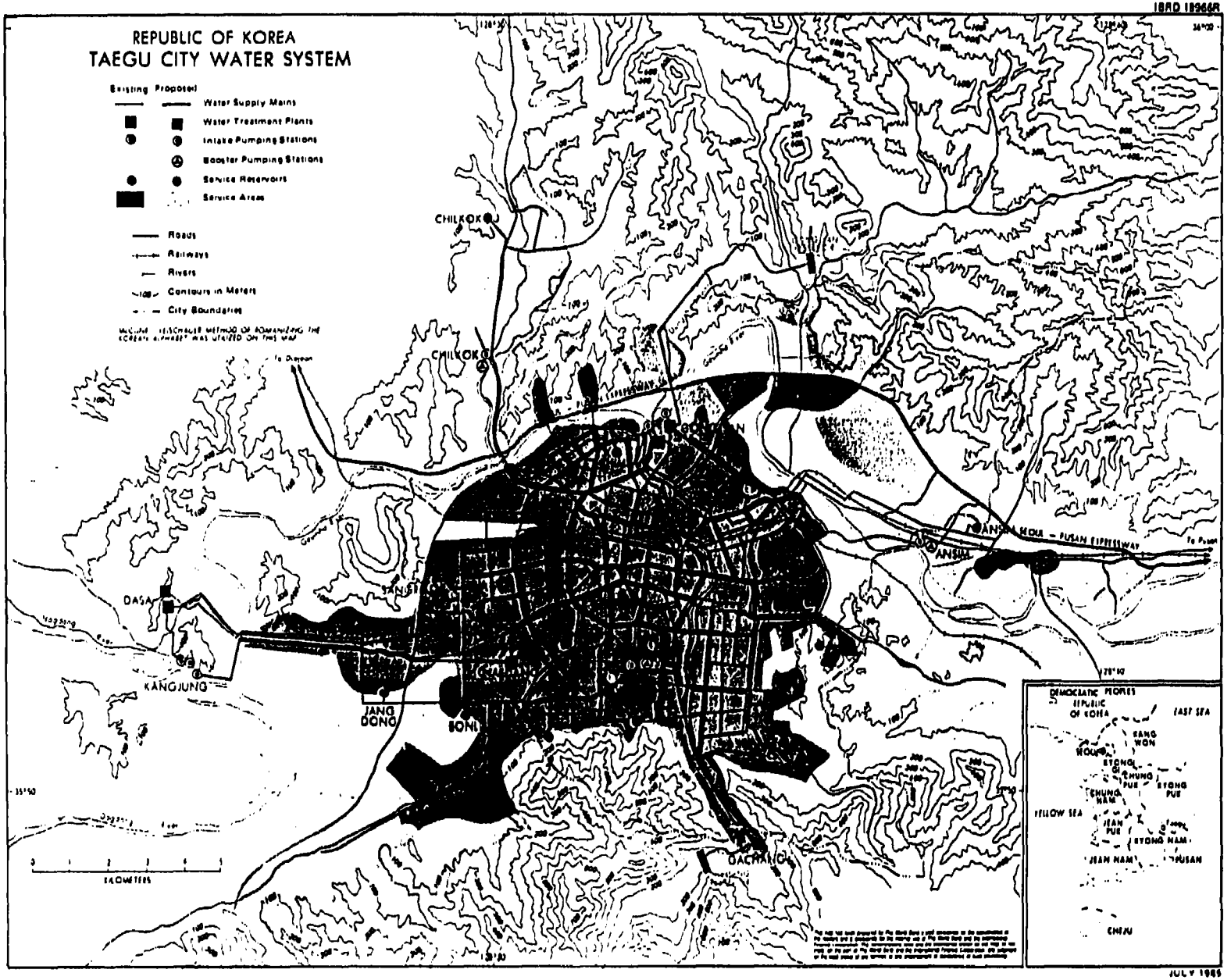


JULY 1985

IBRD 18966R



JULY 1966